

**AIRS Near-Realtime Retrievals in support of the
TEXas Air Quality Study (TEXAQS) II
Gulf of Mexico Atmospheric Composition and
Climate Study (GoMACCS)**

**Texas Commission on Environmental Quality (TCEQ), NOAA, NASA
(www.etl.noaa.gov/programs/2006/texaqs)**

**August 30 – September 1, 2006 Case Study:
Synthesis of EPA AIRNOW, NOAA P3, NASA AIRS obs.
and RAQMS chemical analyses**

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Tom Ryerson, John Holloway, Dirk Richter (NOAA ETL)

Chris Barnet, Walter Wolf (NOAA/NESDIS)

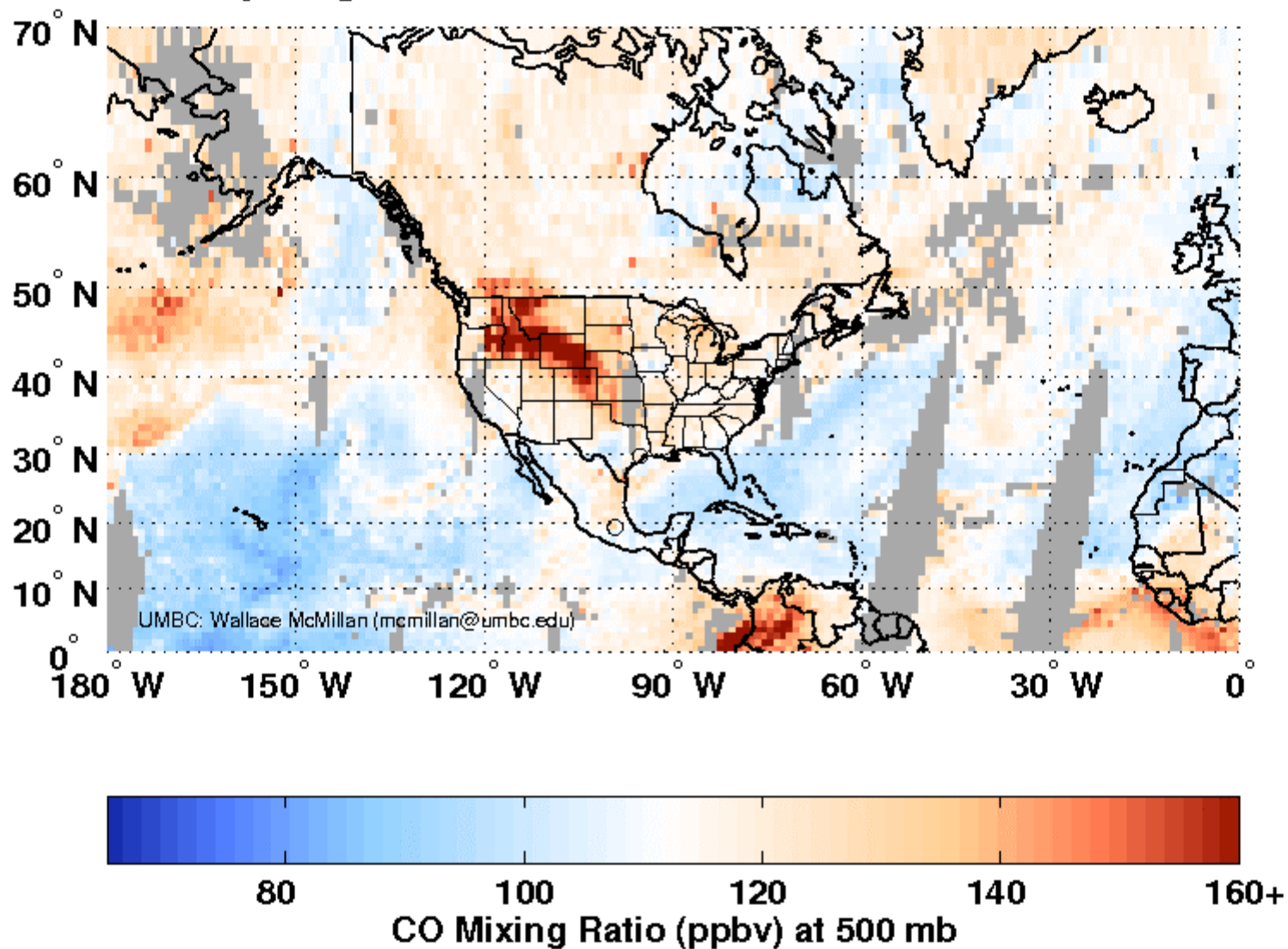
supported by

NASA Tropospheric Chemistry and ACMAP Programs

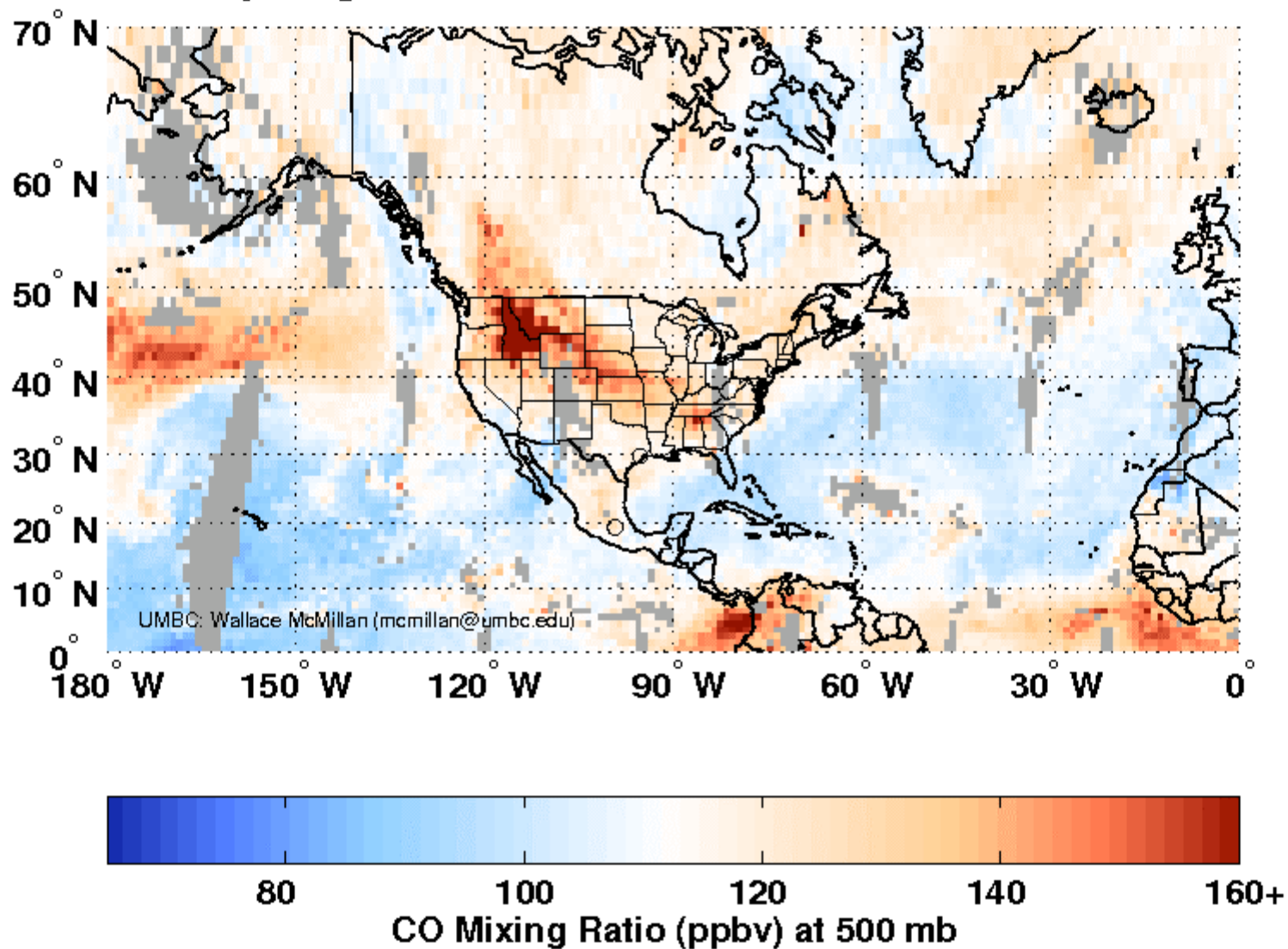
AIRS for TEXAQS

- Greater Houston area is home to a substantial portion of the United States petrochemical processing facilities
- Near-realtime AIRS CO and O₃ maps, data, and trajectory forecasts to support daily flight planning
 - NOAA server NRT
 - GES DISC archive and NRT
- Rapid Science Synthesis (RSS) to support development of Texas State Implementation Plan (SIP) for EPA
 - First draft due October 31, 2006!
 - Final version due early 2007 to EPA
 - AIRS CO addresses two of six critical questions regarding impacts of distance sources and background on Texas air quality
- Surface sites, numerous NOAA, NASA, and Texas aircraft, several models, AIRS, MISR, TES
- TEXAQS, INTEX-A, INTEX-B maps and data online:
<http://physics.umbc.edu/~mcmillan>

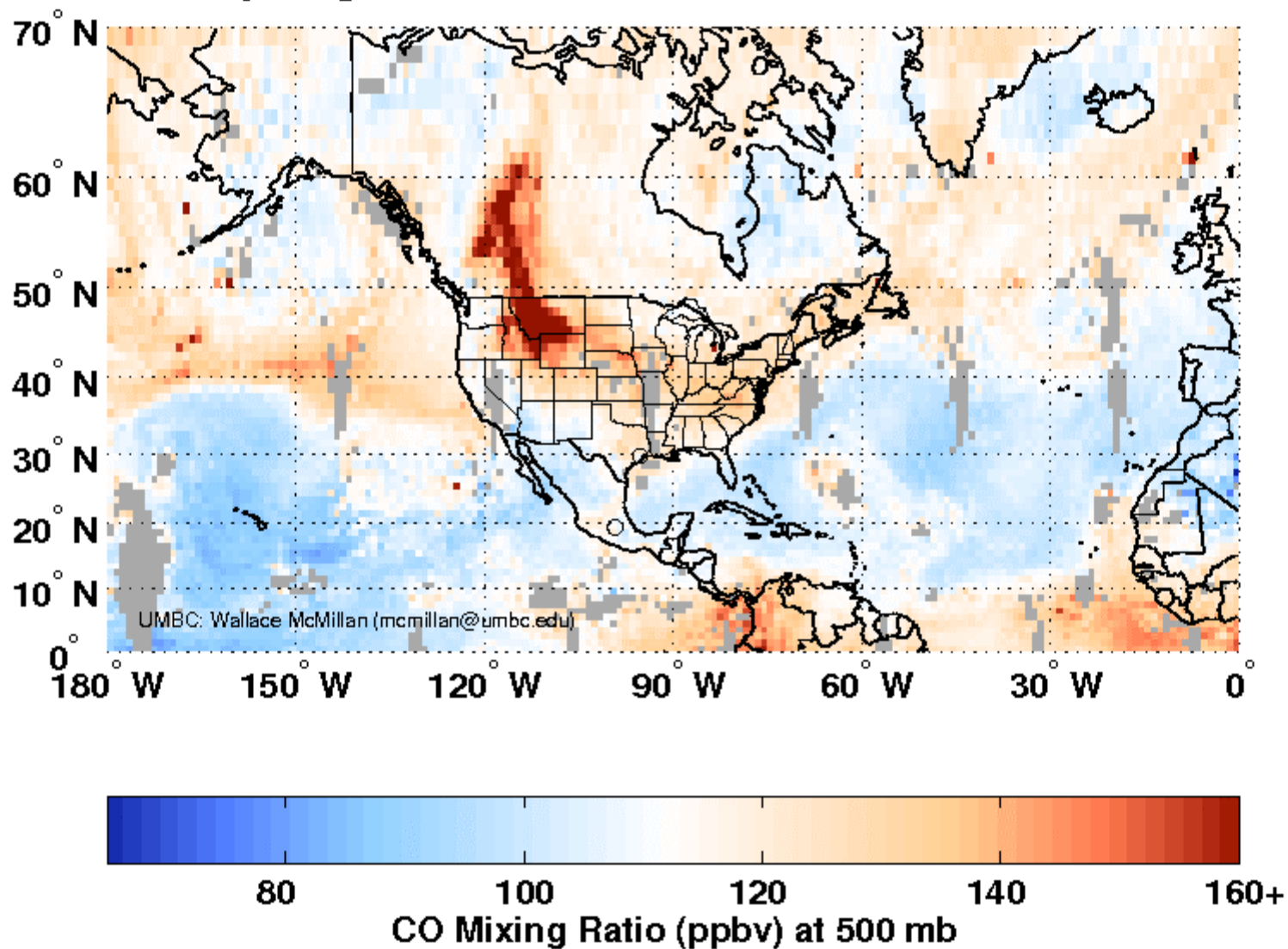
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060907



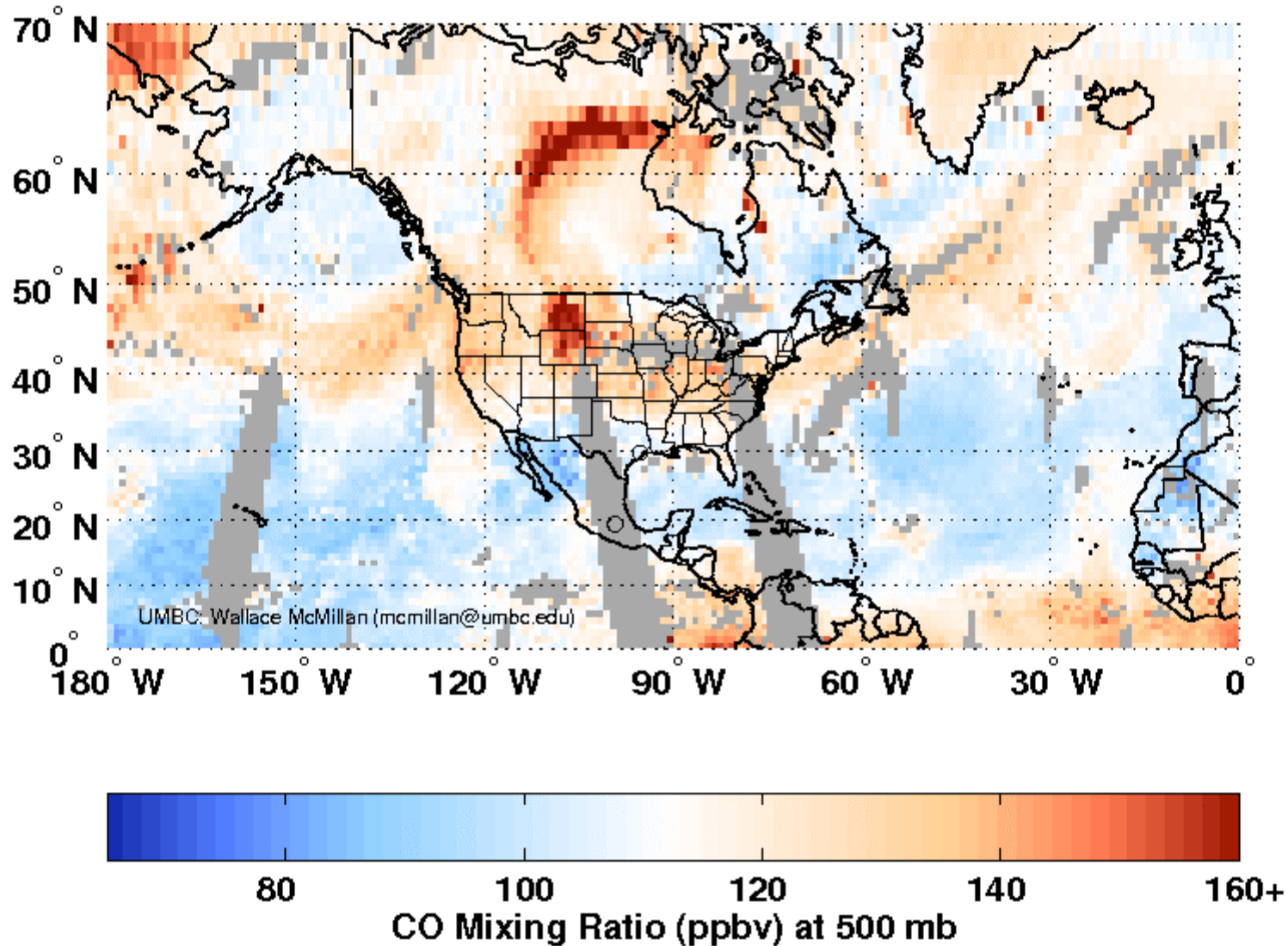
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060908



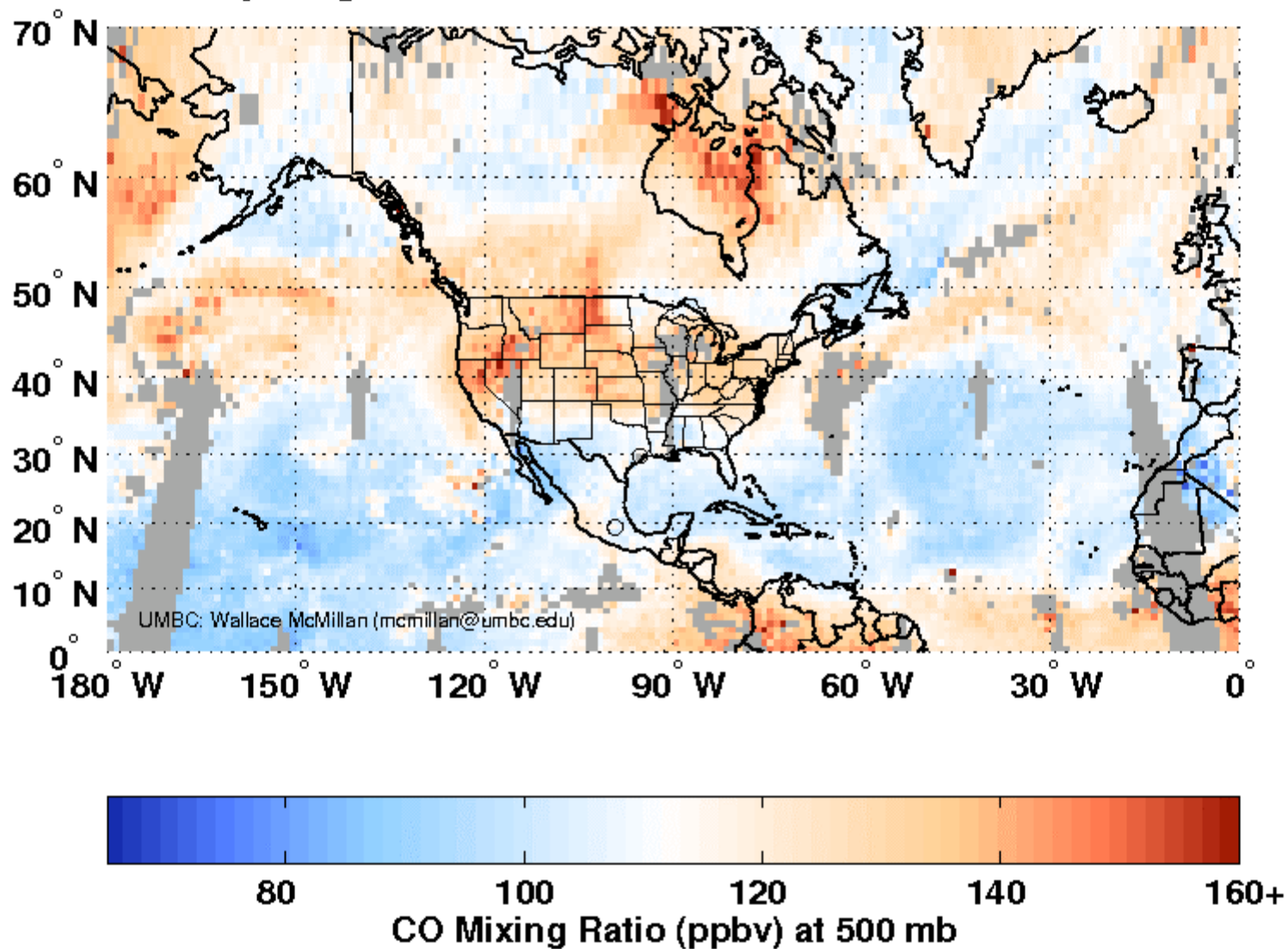
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060909



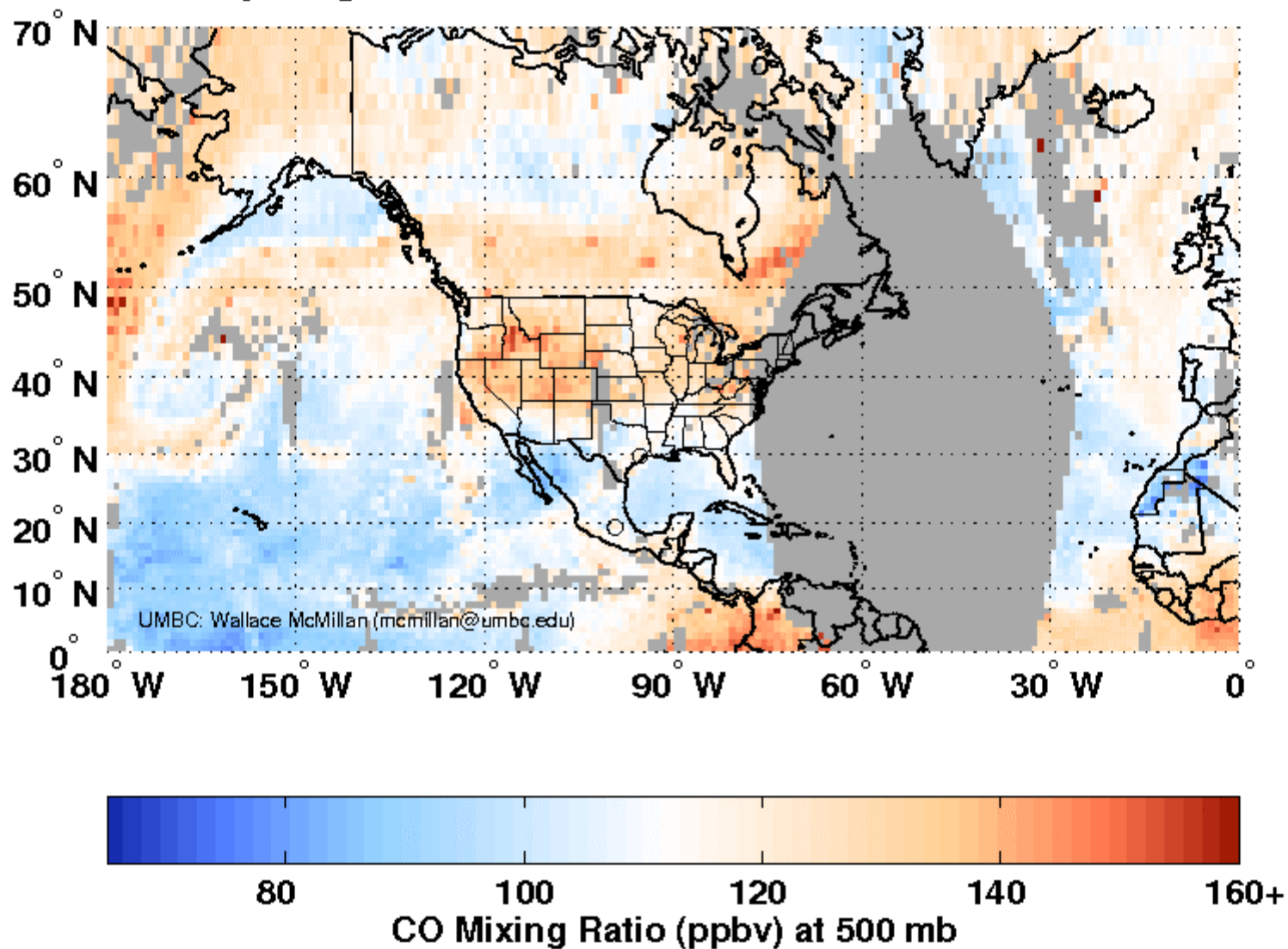
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060910



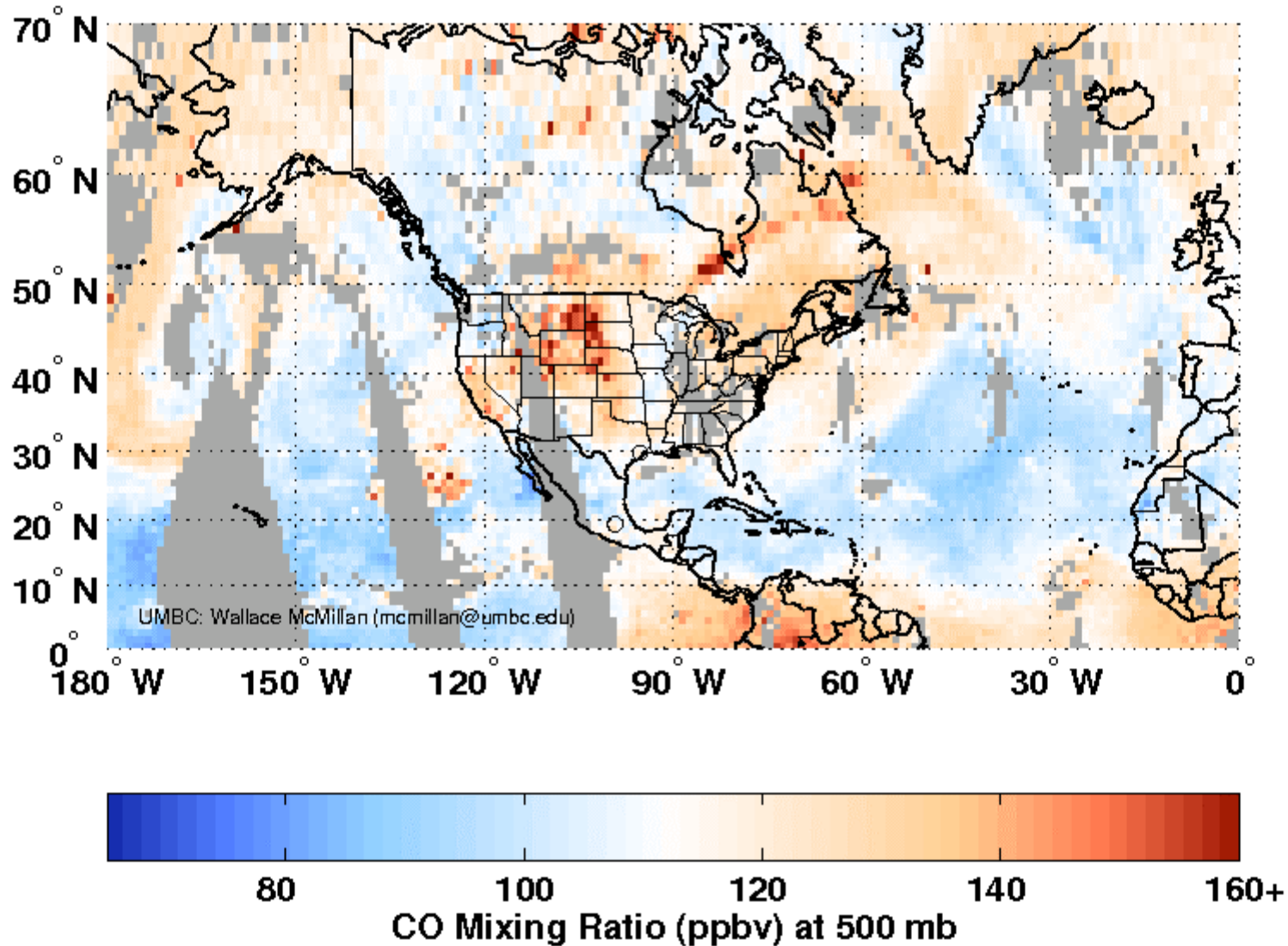
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060911

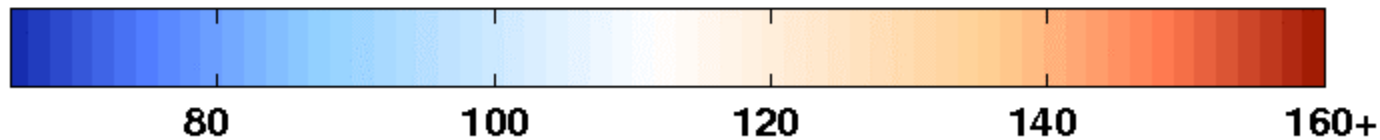


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060912

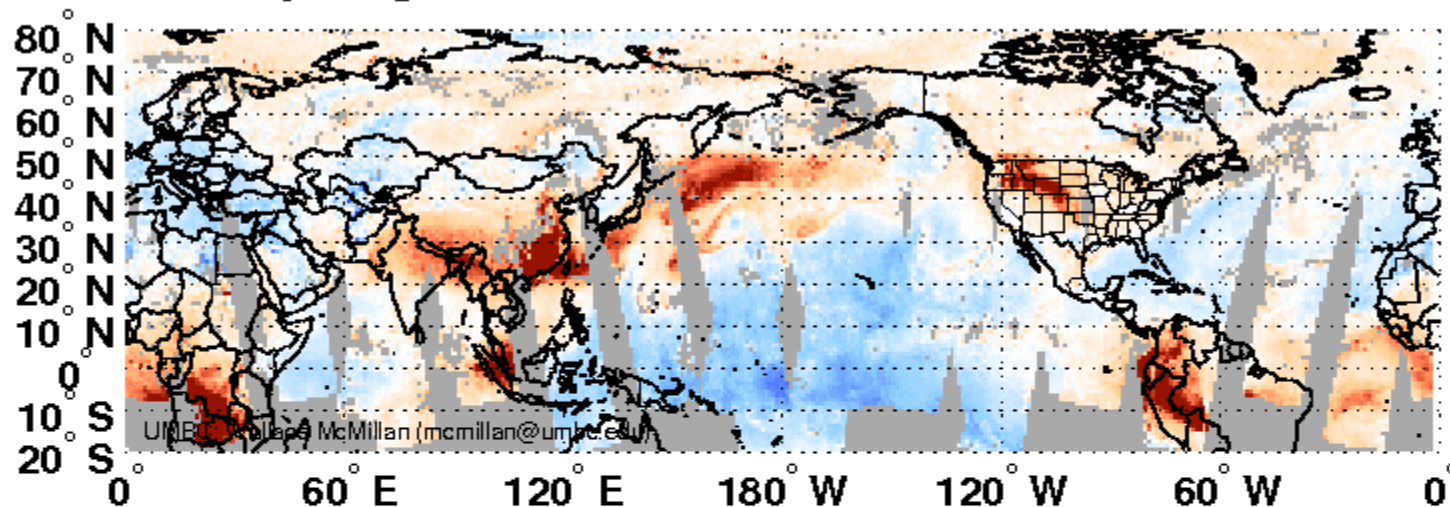


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060913

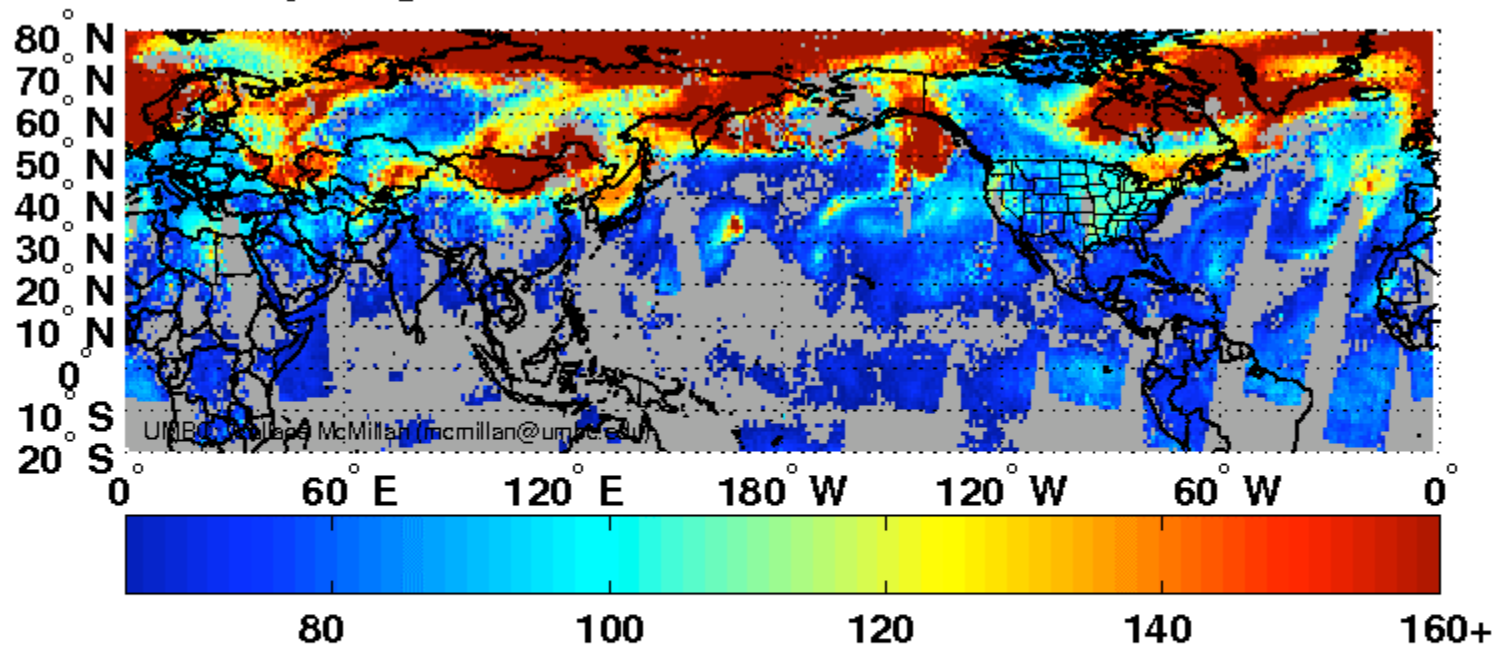


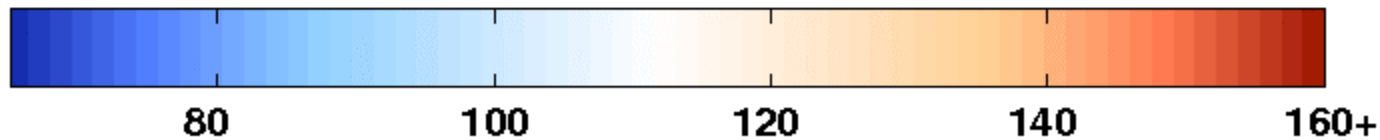


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060907

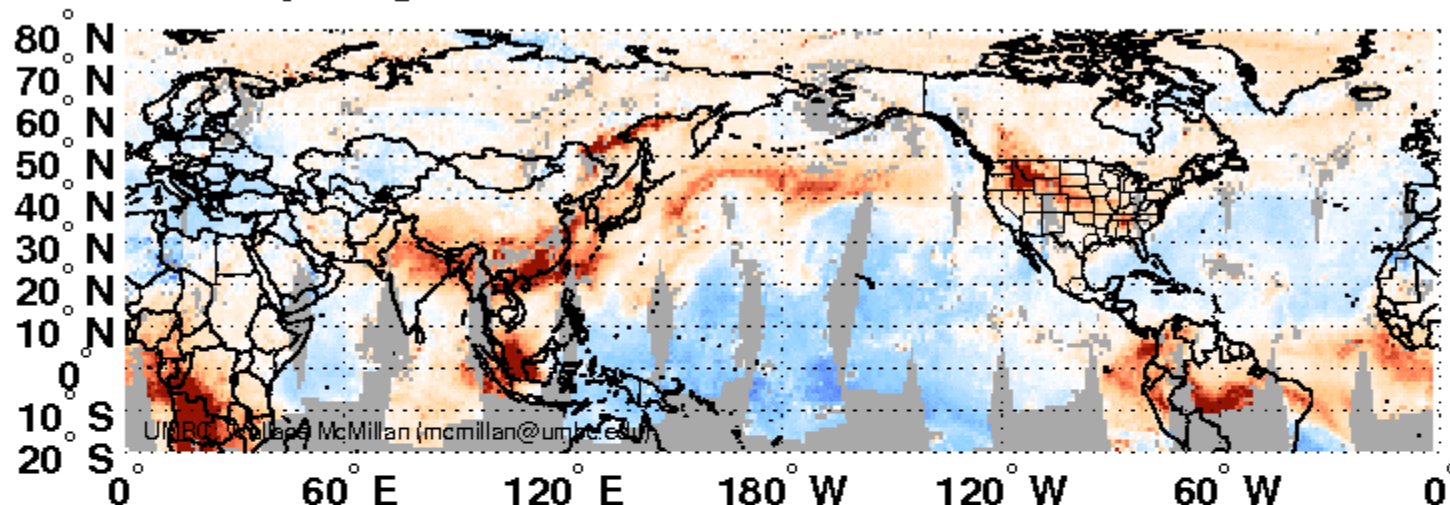


Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060907

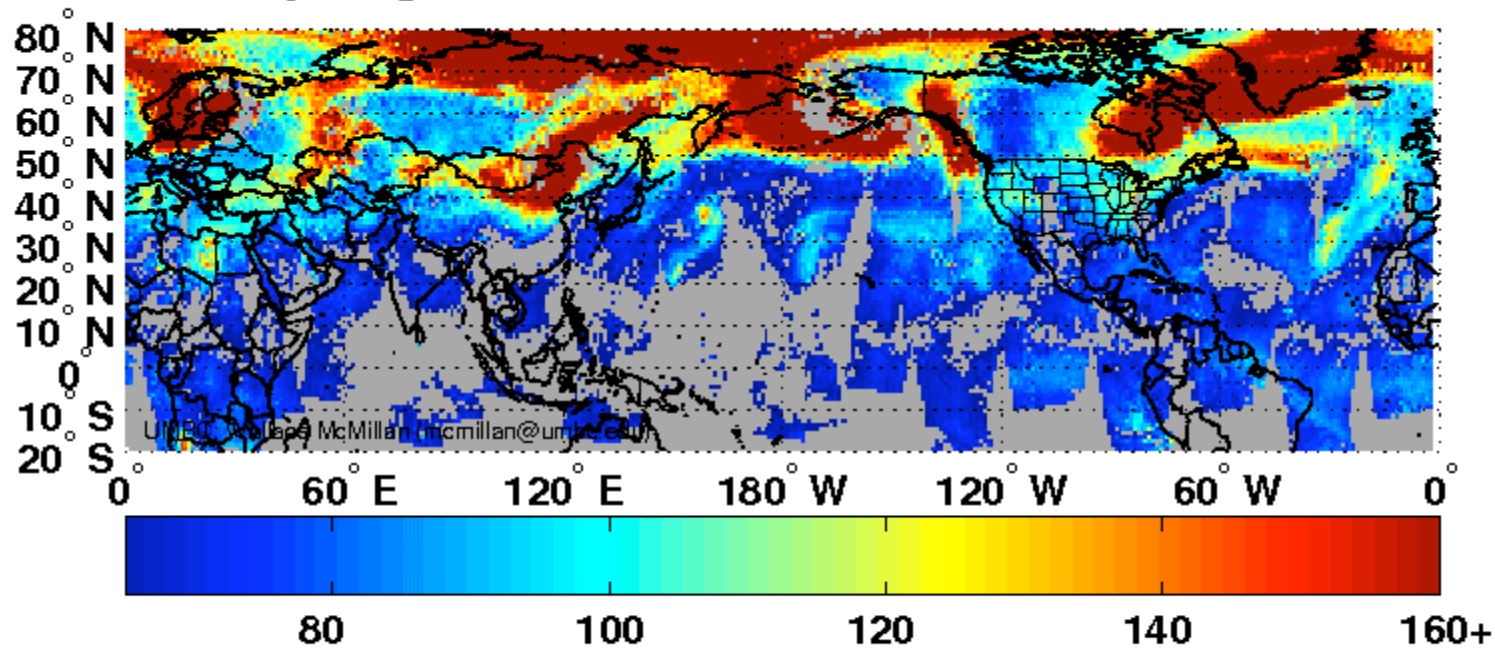


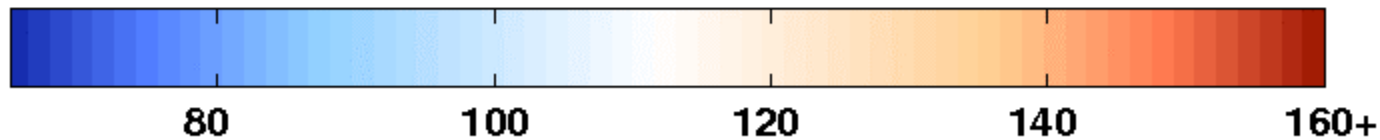


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060908

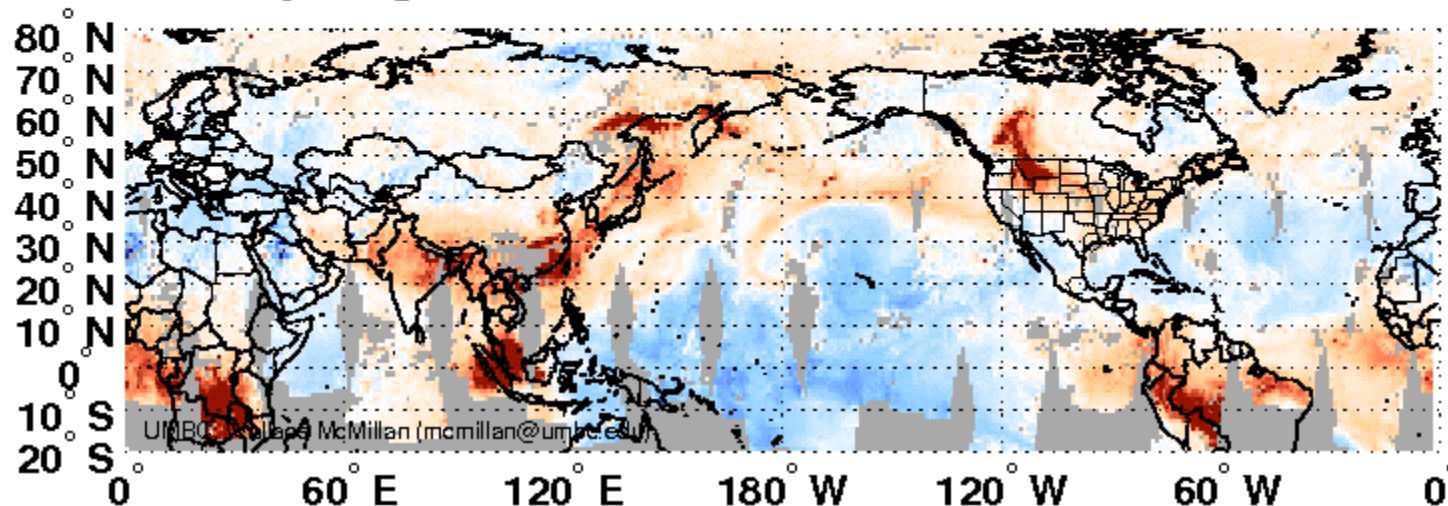


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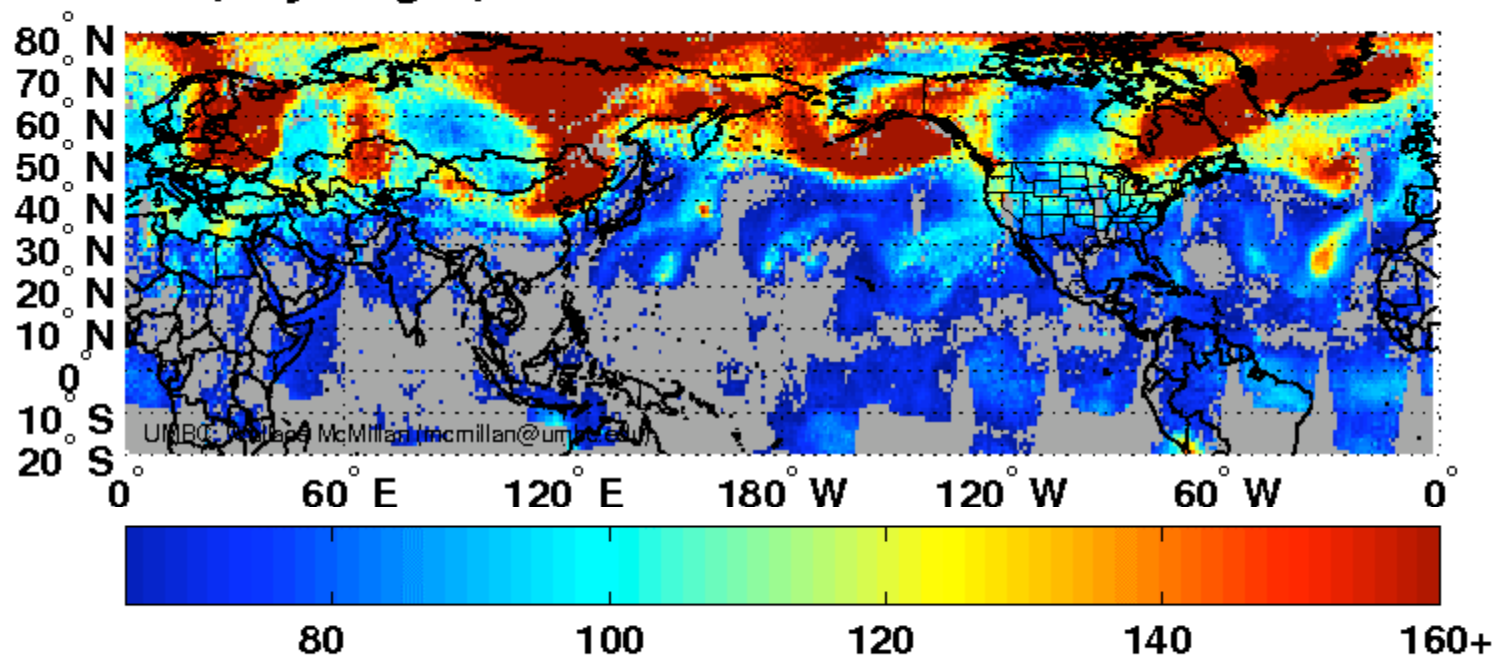


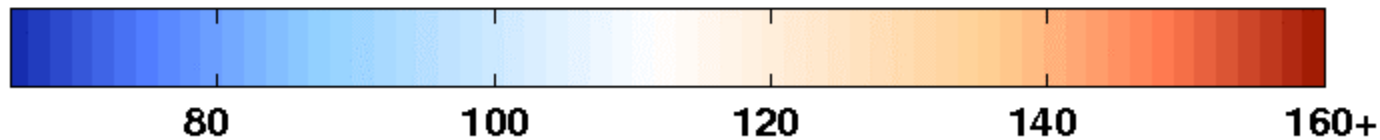


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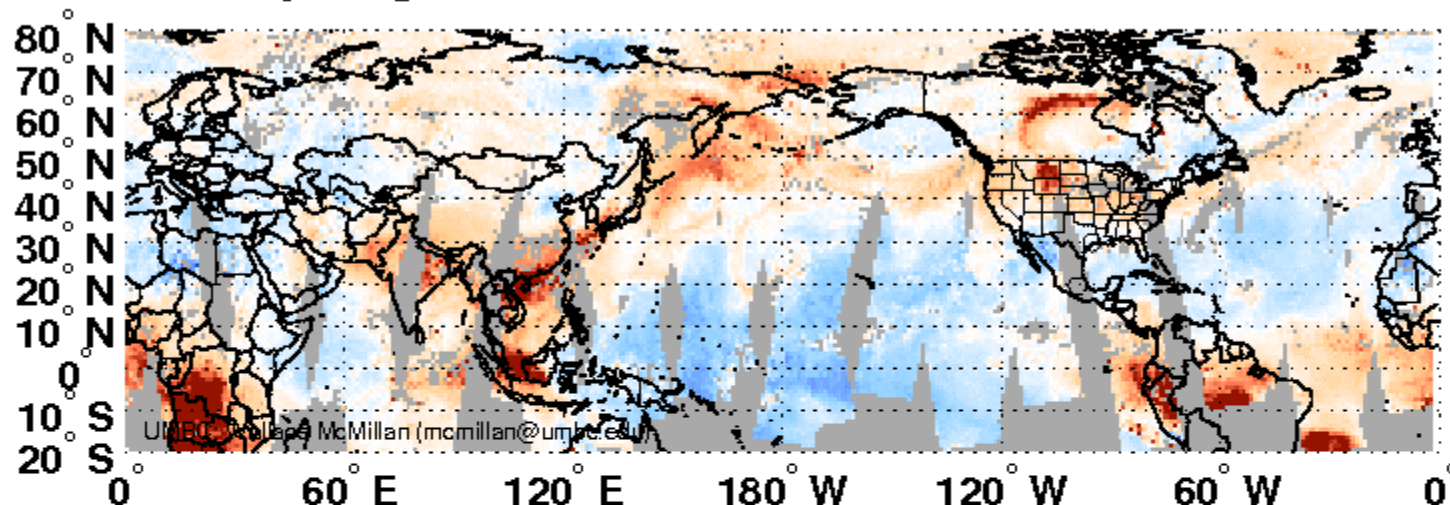


Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060909

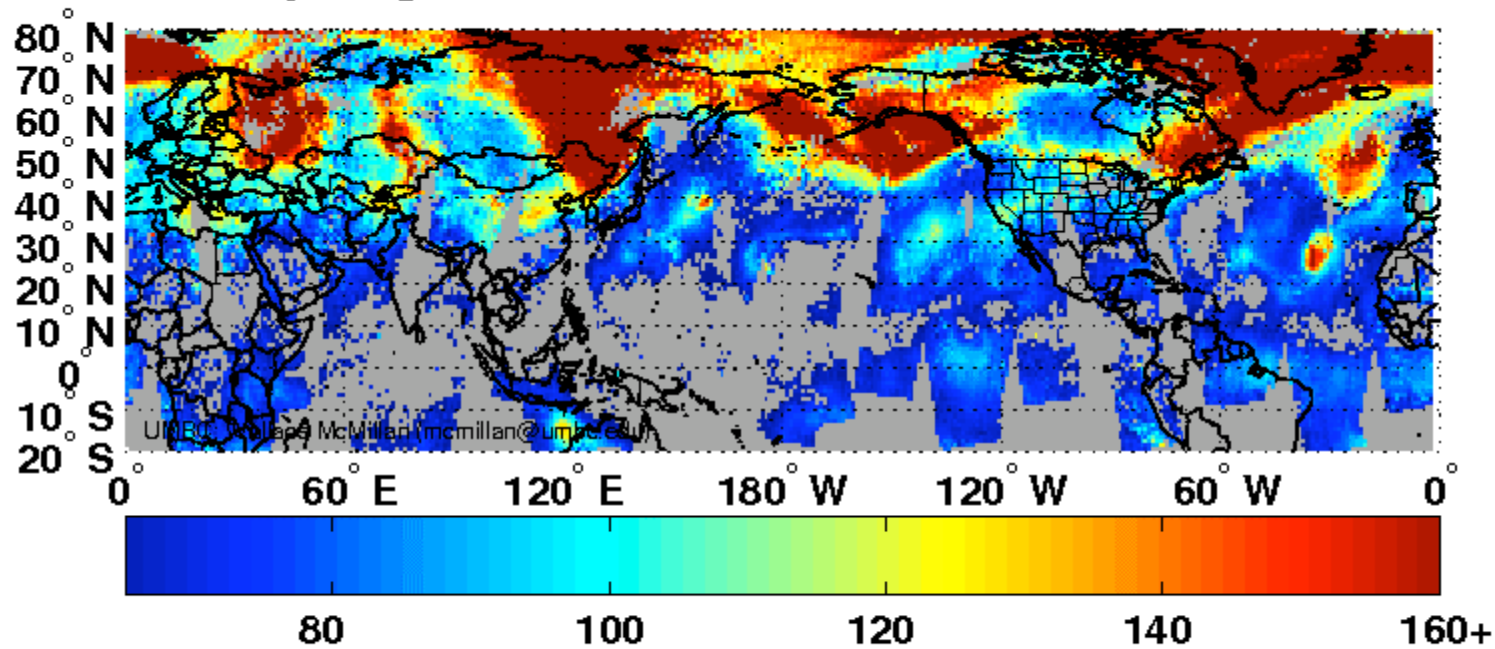


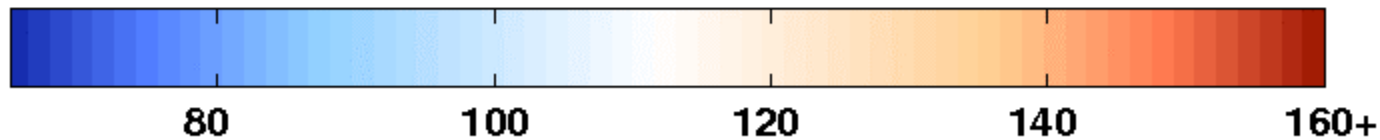


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060910

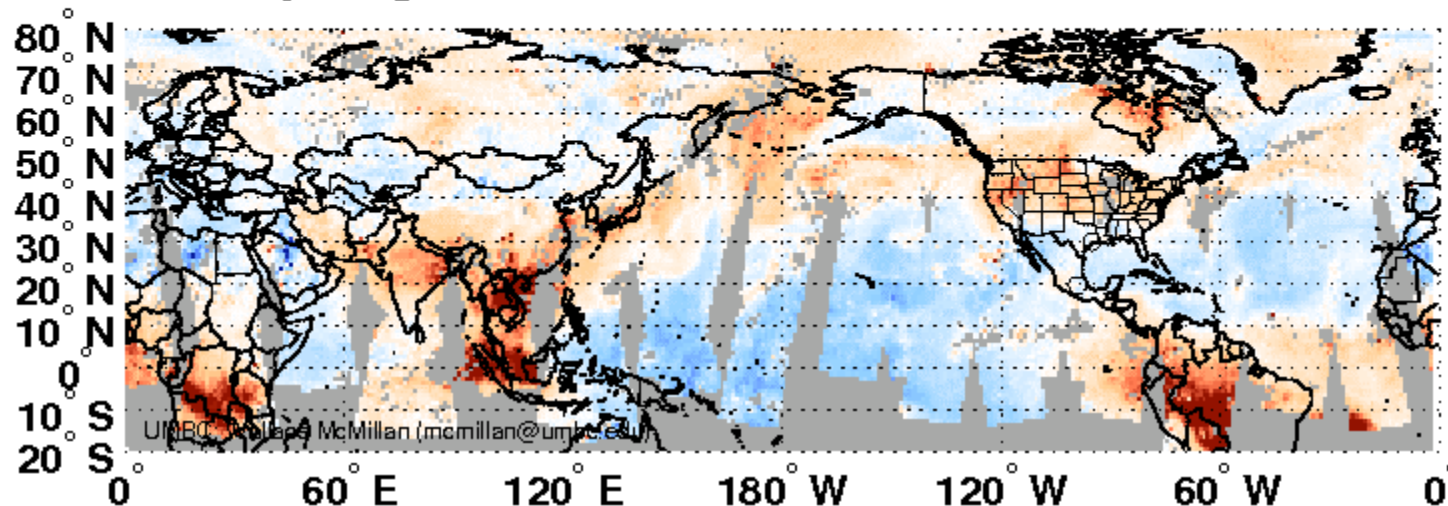


Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060910

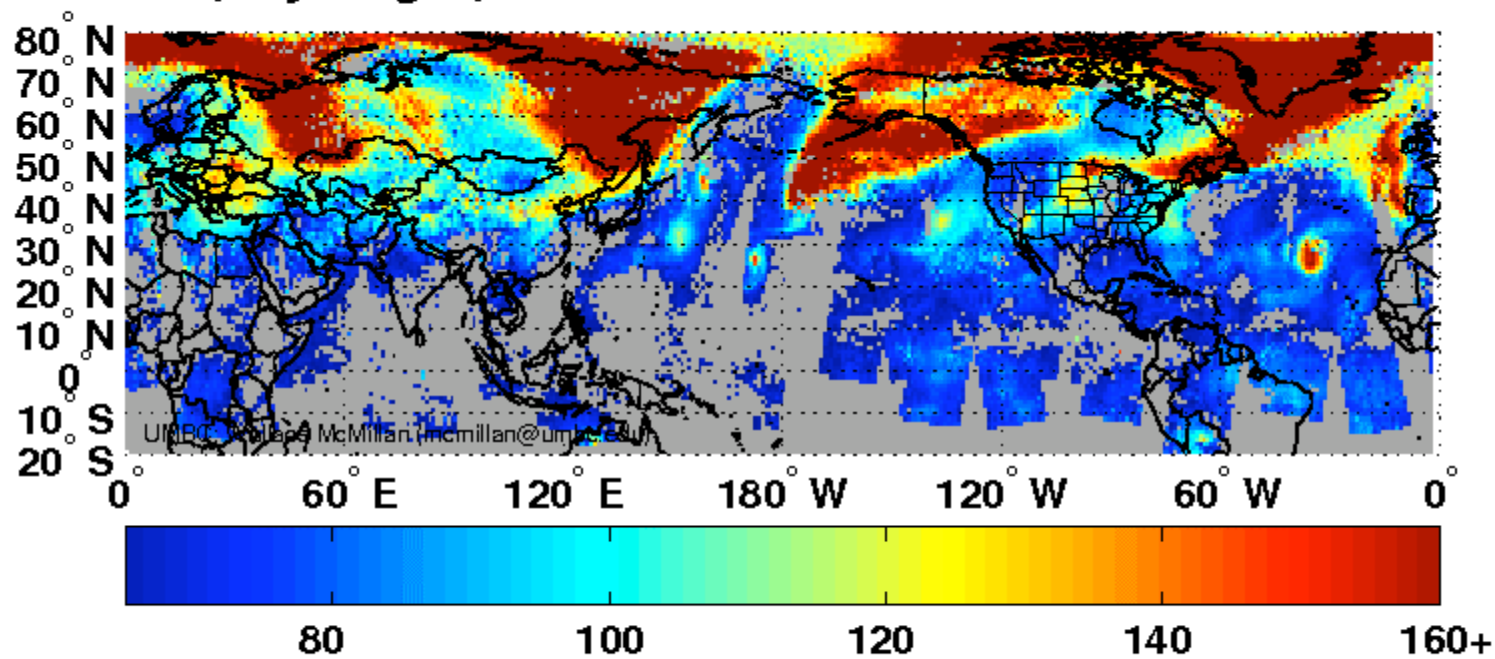


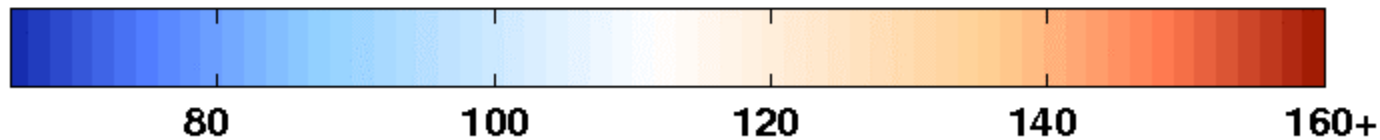


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060911

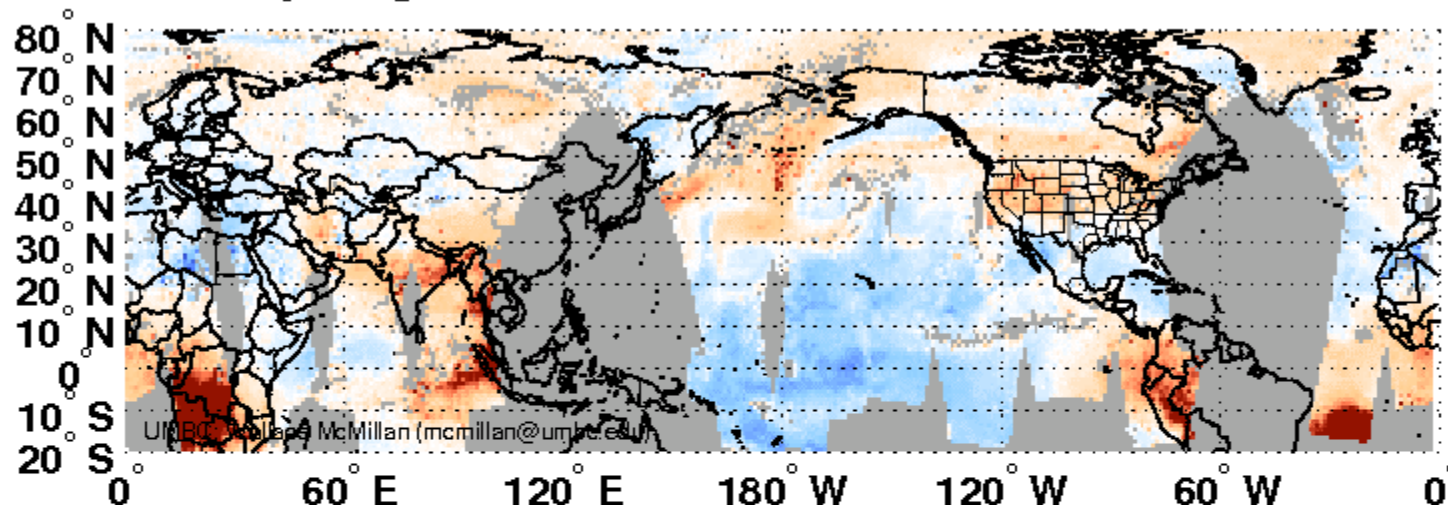


Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060911

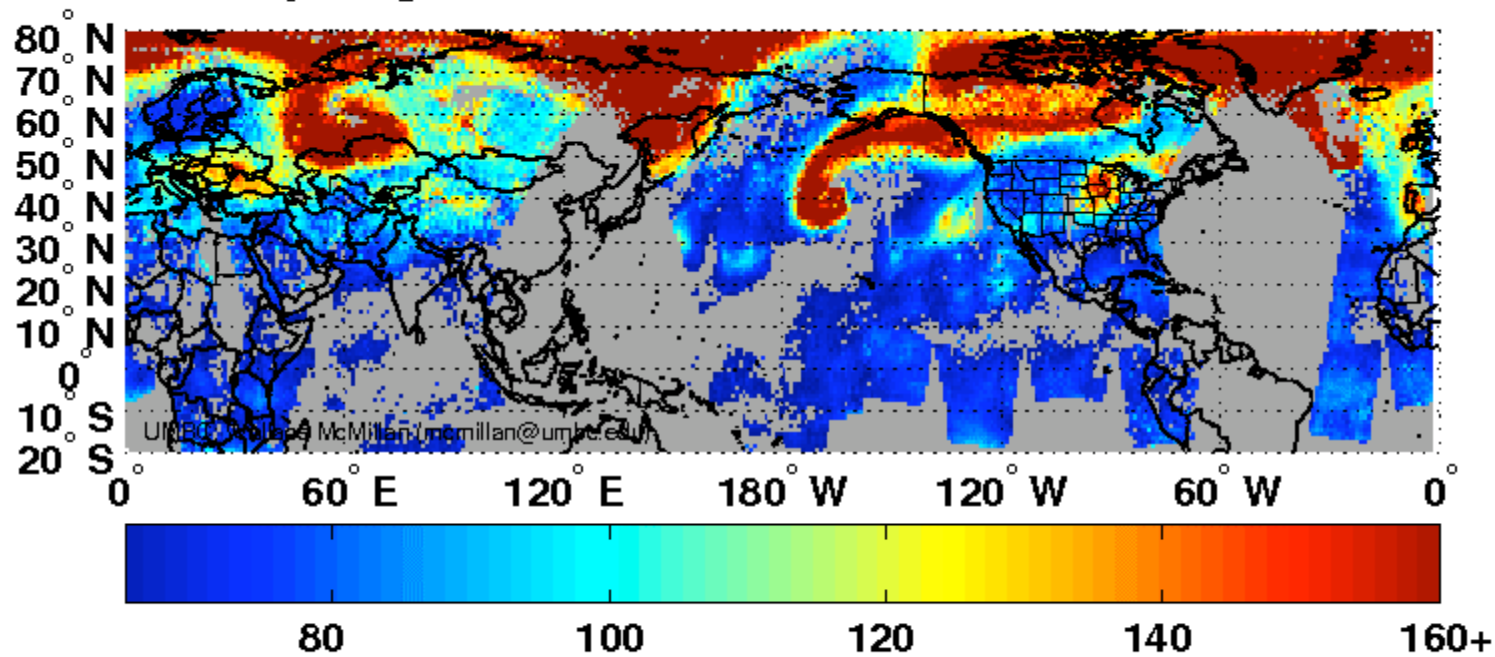


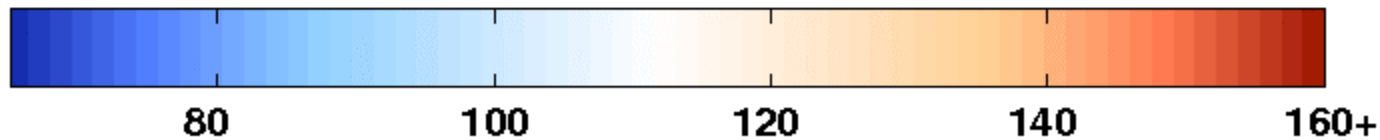


Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060912

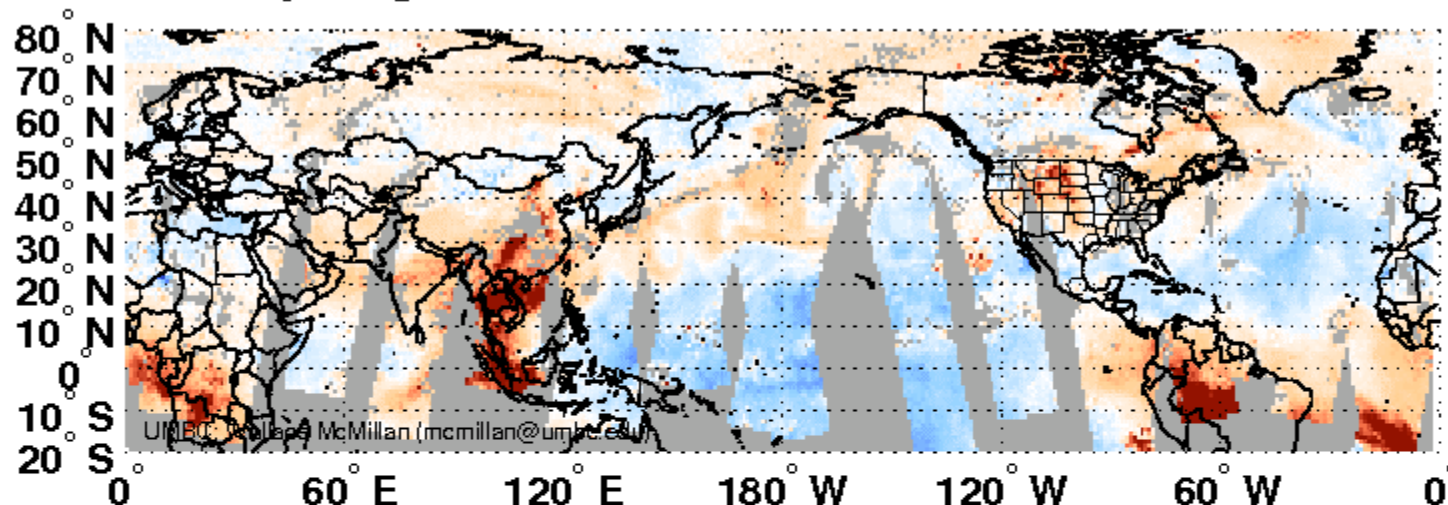


Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060912

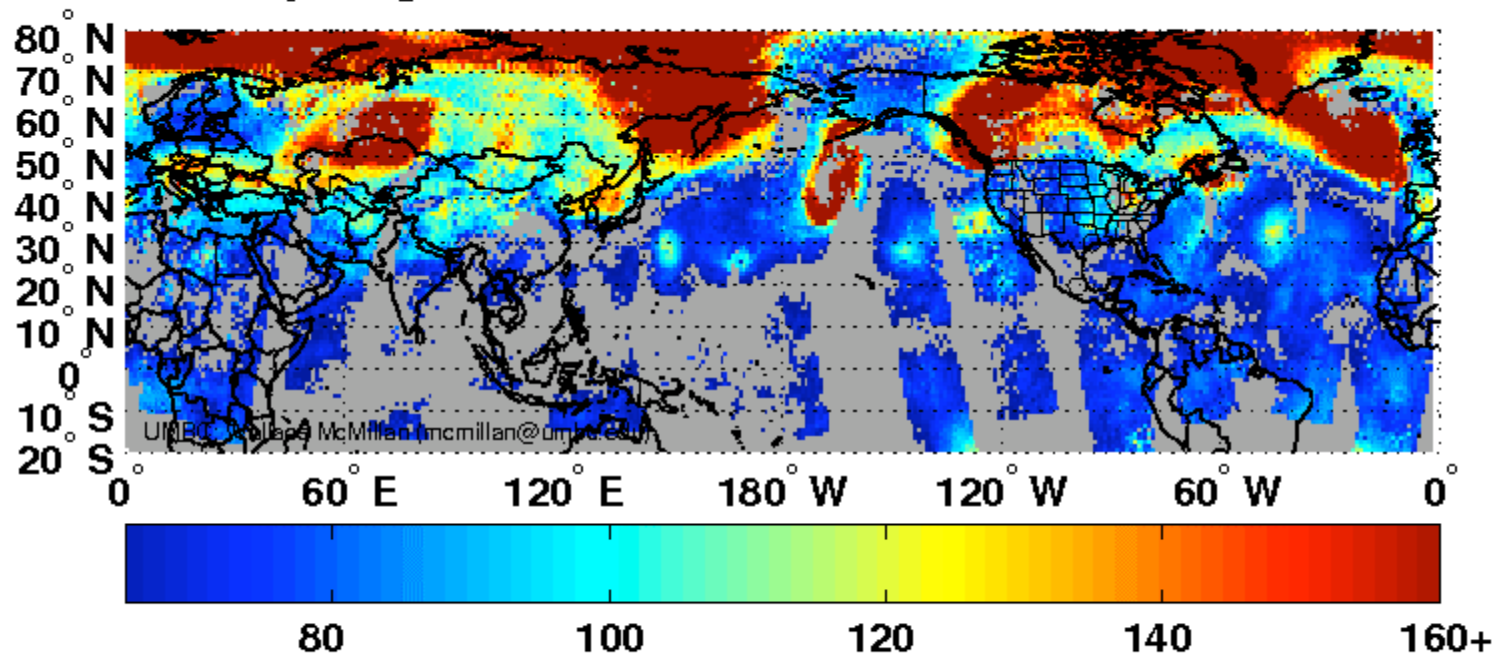




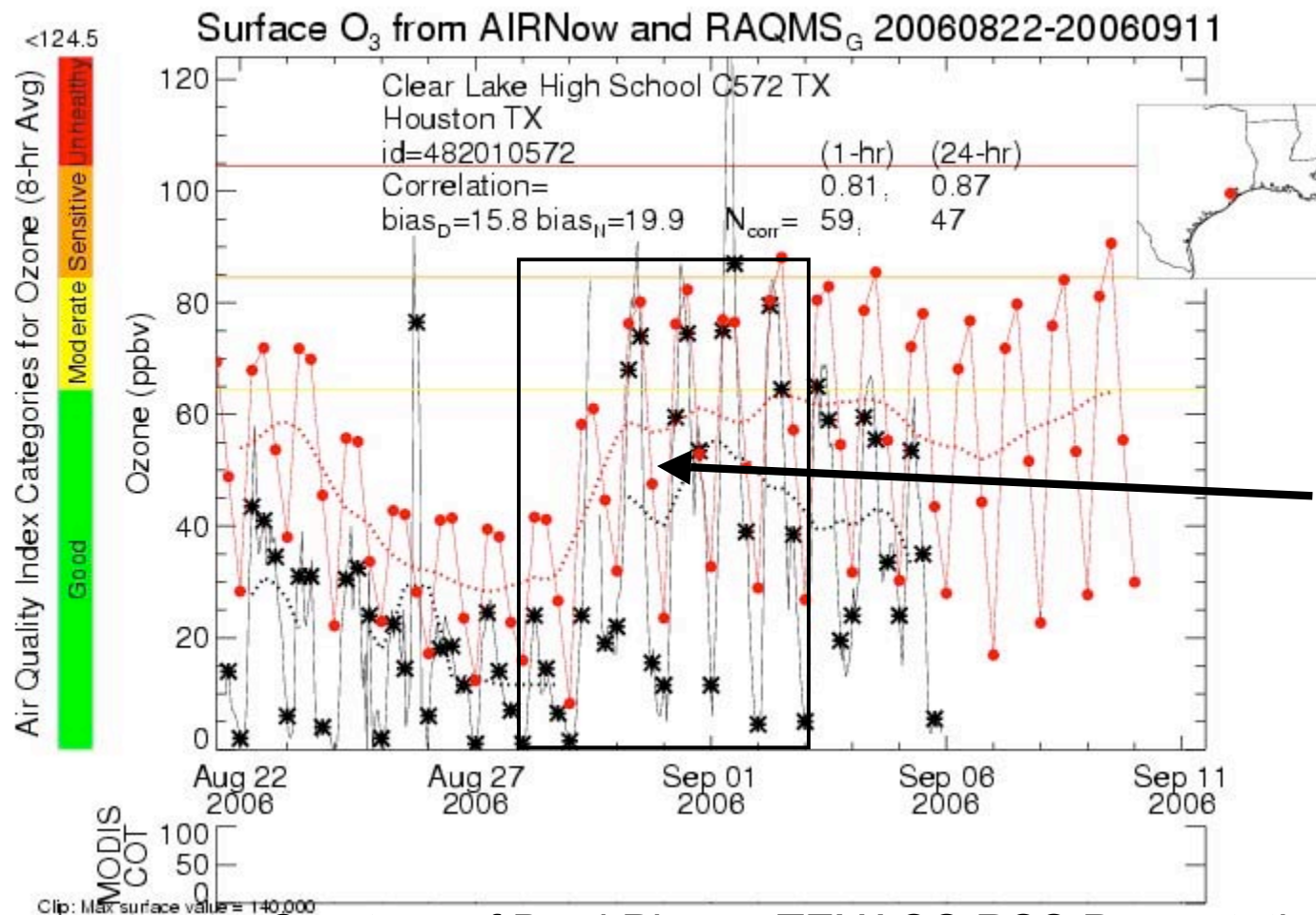
Local AP (day+night) AIRS CO at 500 mb from DAAC on 20060913



Local AP (day+night) AIRS O3 at 266 mb from DAAC on 20060913



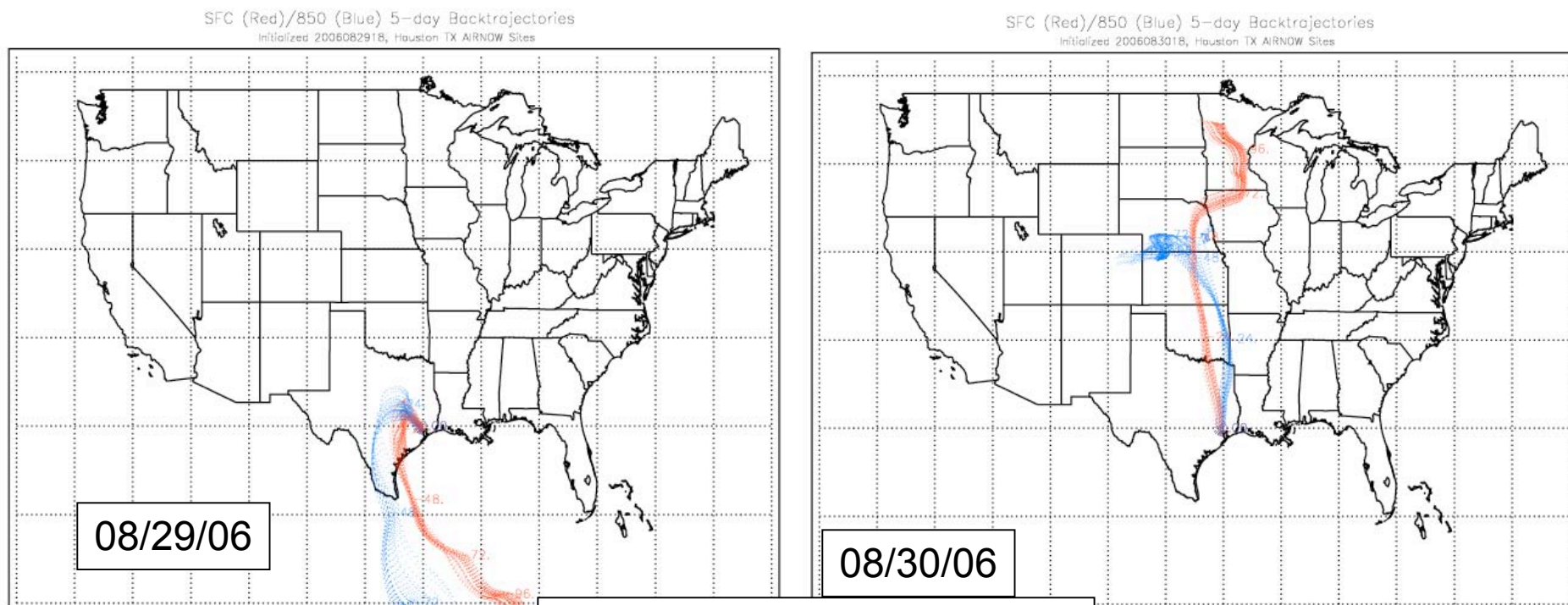
RAQMS Model Predicted Regional Influence On Houston Ozone Air Quality Event (8/30-9/2/06)



24hr averaged
ozone shows
30ppbv
enhancement
during the period
that could be due
to regional
transport

Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

Flow transition from On-shore to Northeasterly

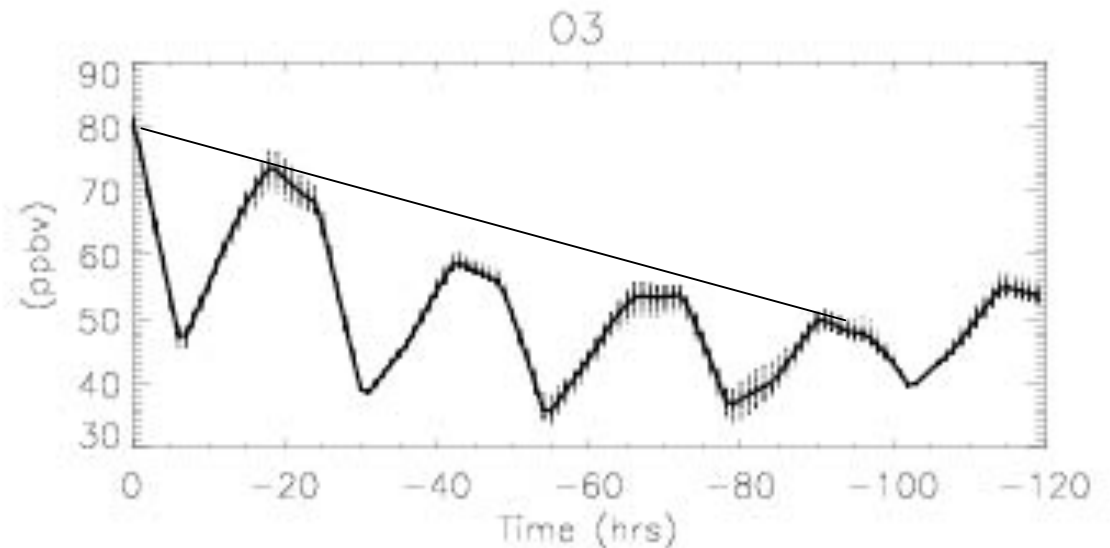


Houston surface (red)
and 850mb (blue) 5-day
back trajectories

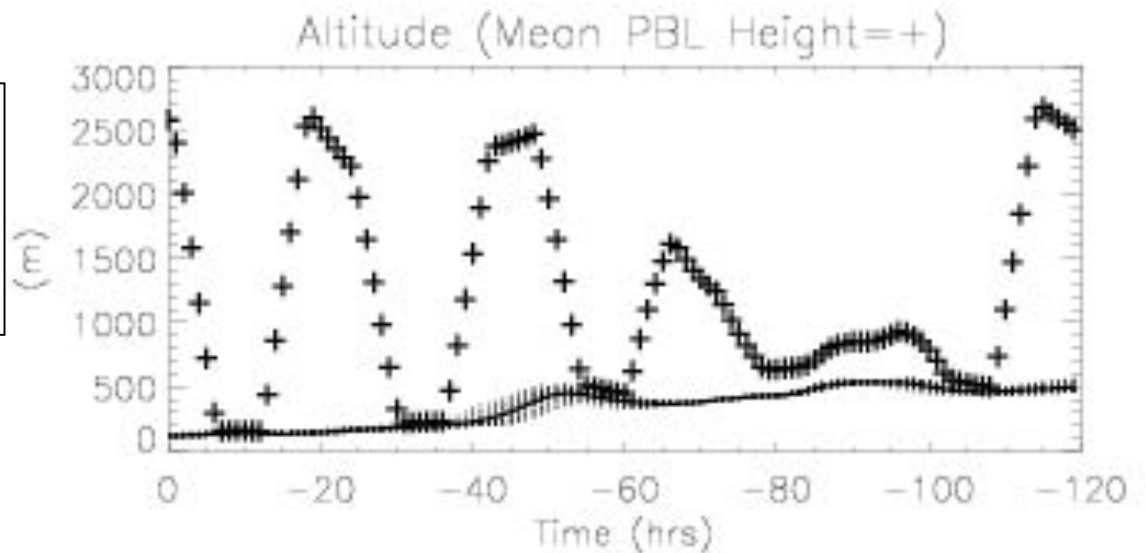
Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

5-day Lagrangian mean ozone mixing ratio, altitude, and pbl height Houston AIRNOW sites 09/01/06

Daily ozone production along back trajectories results in Lagrangian mean ozone increase of nearly 30ppbv during previous 4 days



Trajectories remain within boundary layer during previous 5 days



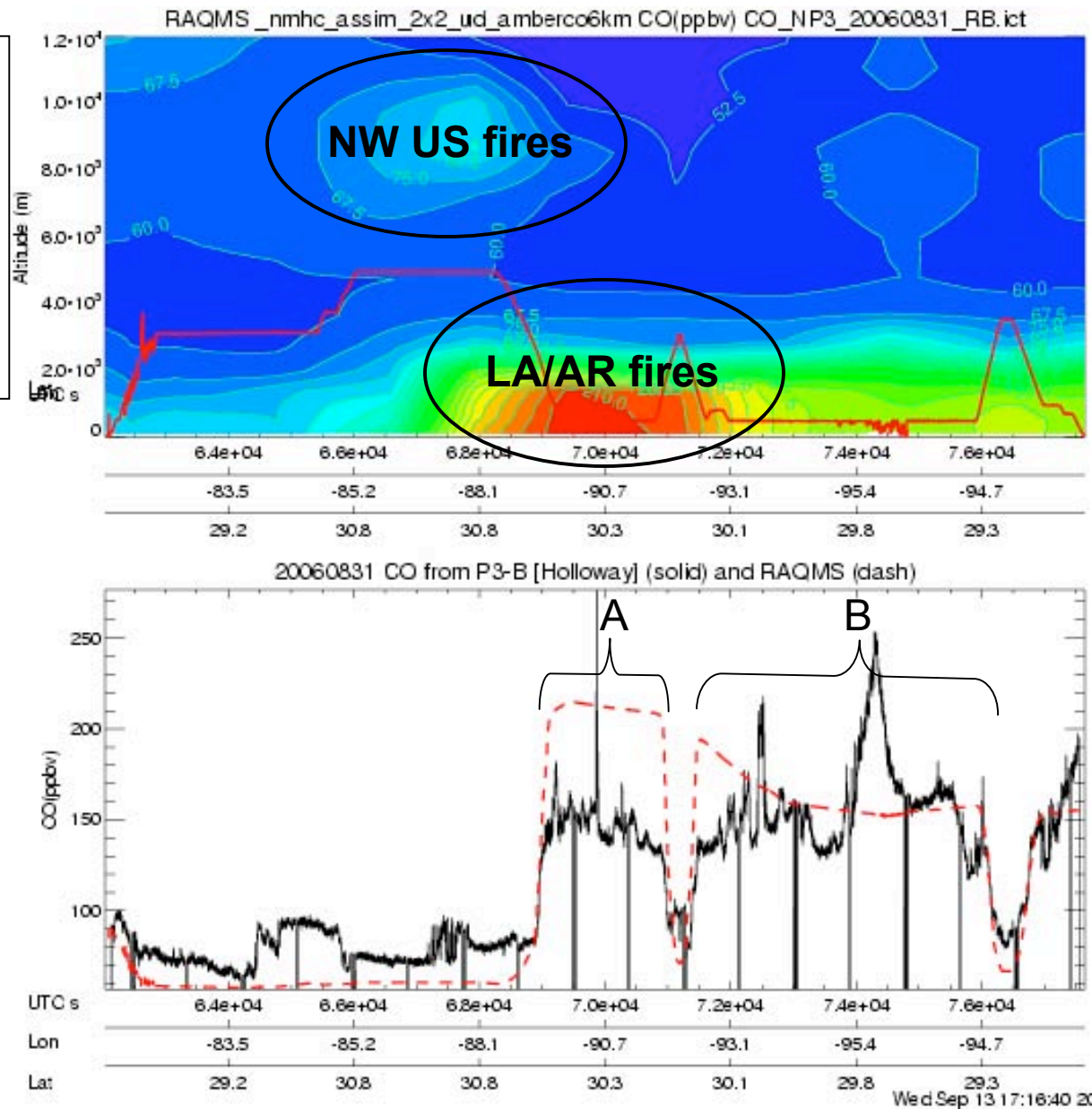
Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

Model Verification: RAQMS vs P3 (Holloway) CO 08/31/06

NOAA P3
measurements provide
verification of regional
scale predictions and
satellite measurements

RAQMS overestimates
Eastern BL CO enhancement
(A) by 50% but does a
reasonable job predicting
enhancements in background
CO on western portion of P3
flight (B).

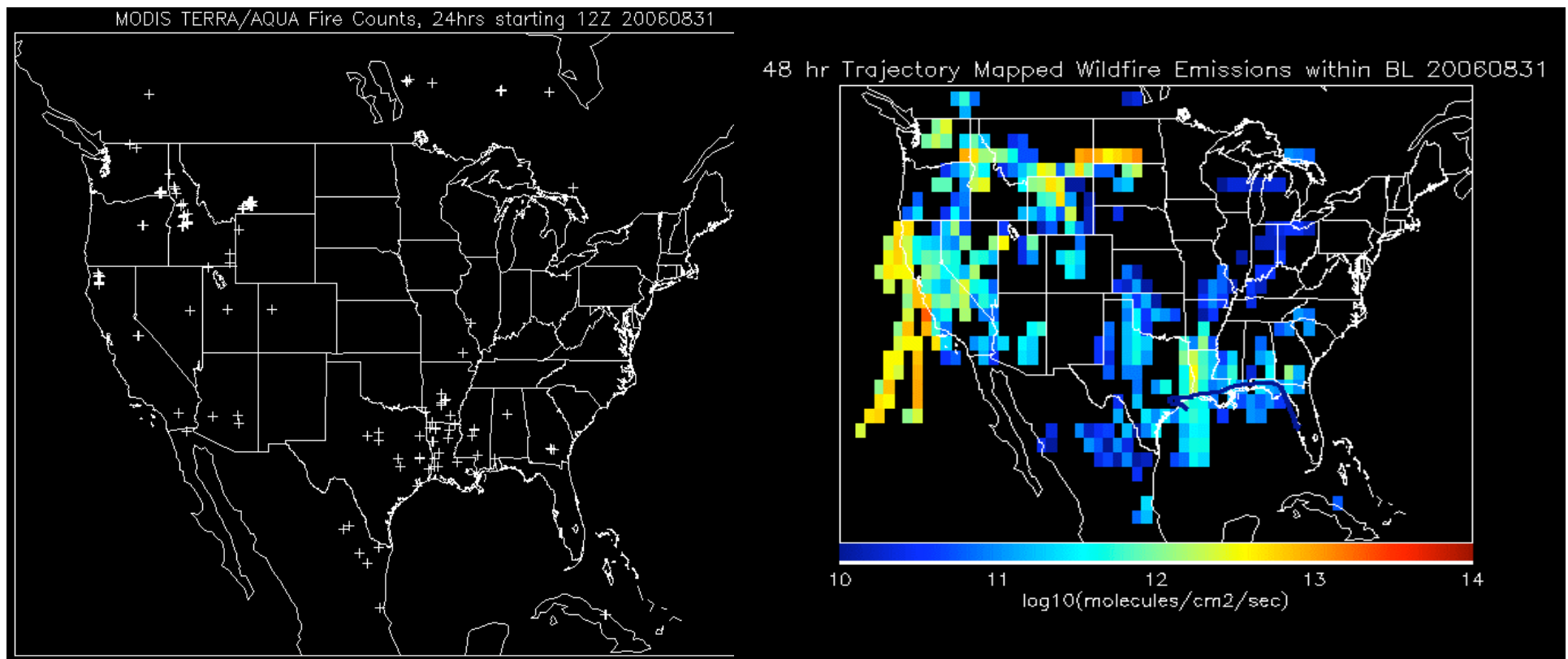
CO enhancements due to local
biomass burning and Houston
are not predicted due to coarse
model resolution



Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

Near field Boundary Layer Wildfire Influences 20060831

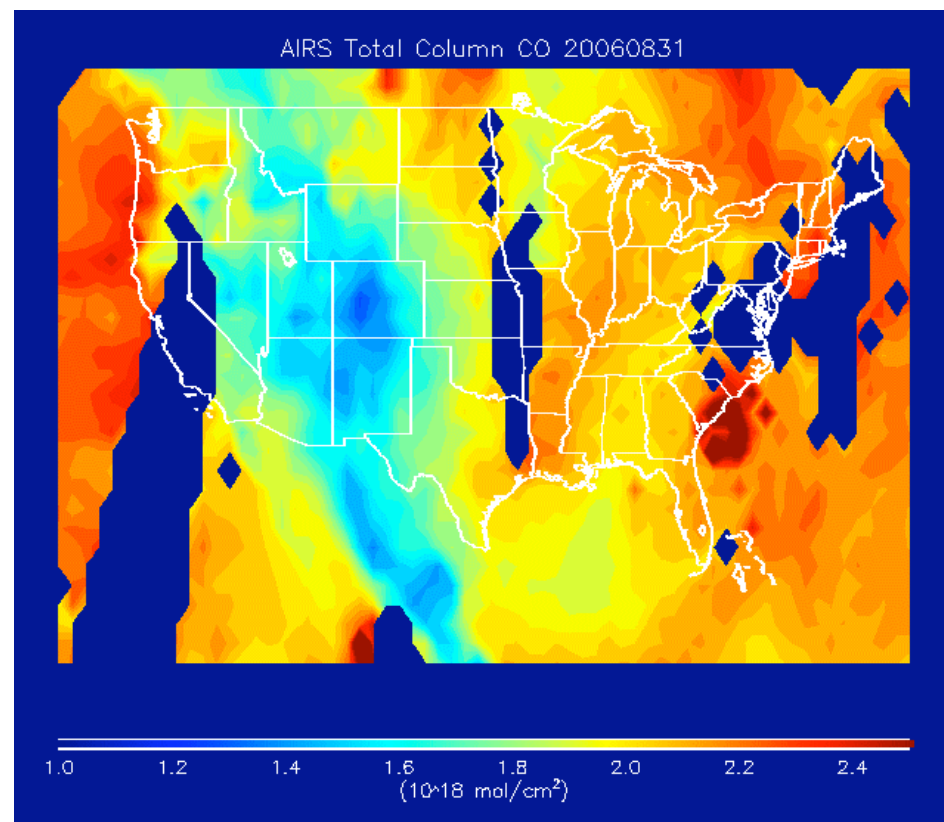
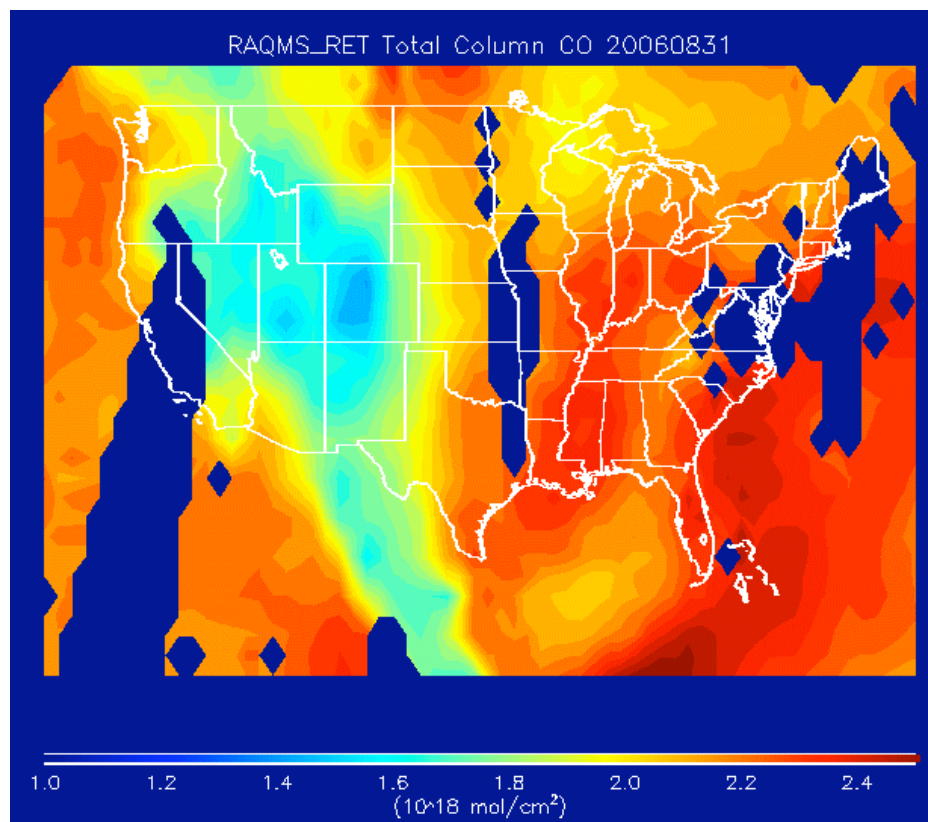
(Ensemble average emission rates computed from 0-48 hr wildfire trajectories found within boundary layer)



Observed, finescale boundary layer CO enhancements along P3 flight track are influenced by recent local biomass burning in Northern Louisiana.

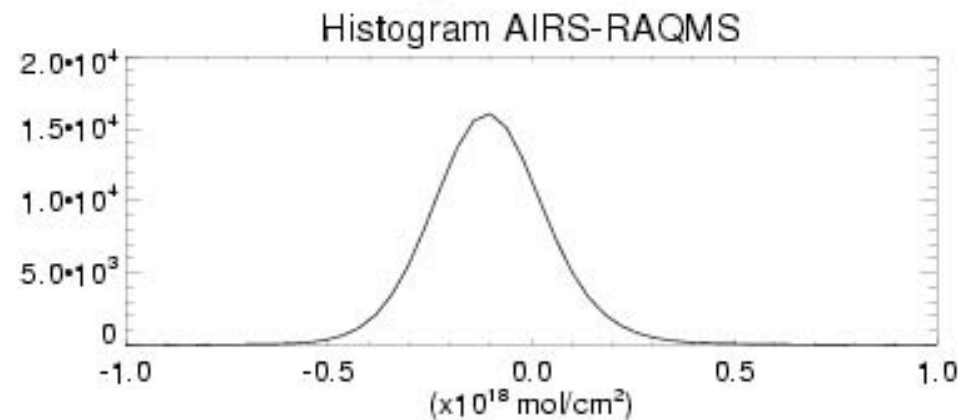
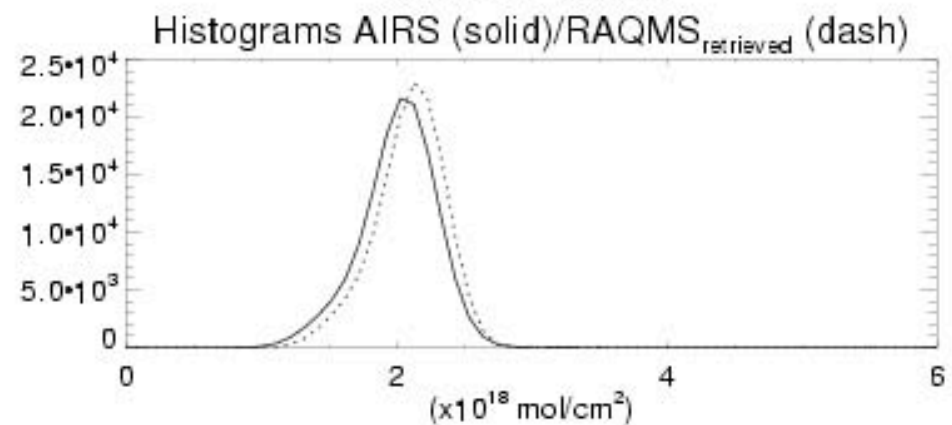
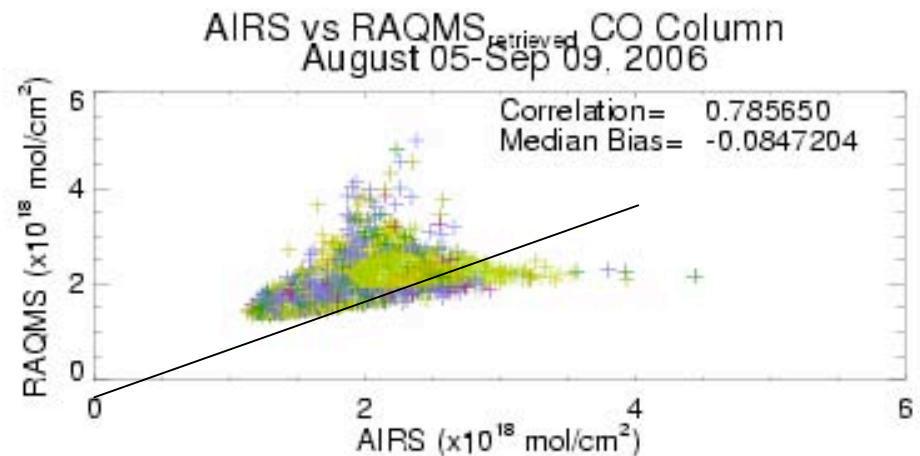
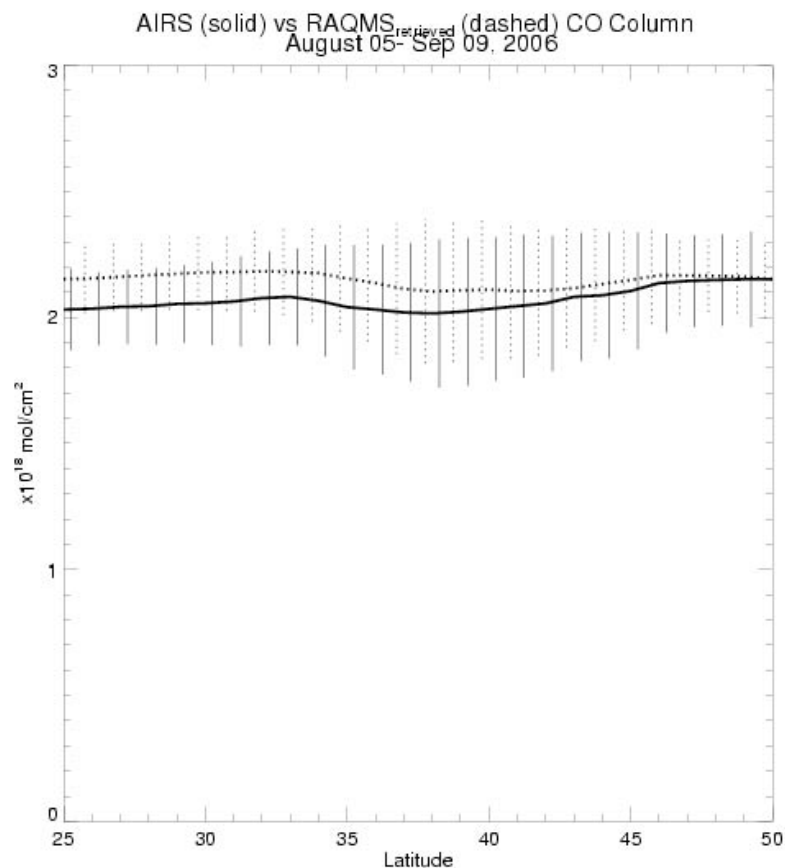
Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

AIRS vs RAQMS Total Column CO 20060831 (AIRS verticality function applied to RAQMS)



AIRS provides verification of model predictions and a regional context for P3 measurements: CO, O₃, H₂O, Temperature

Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06



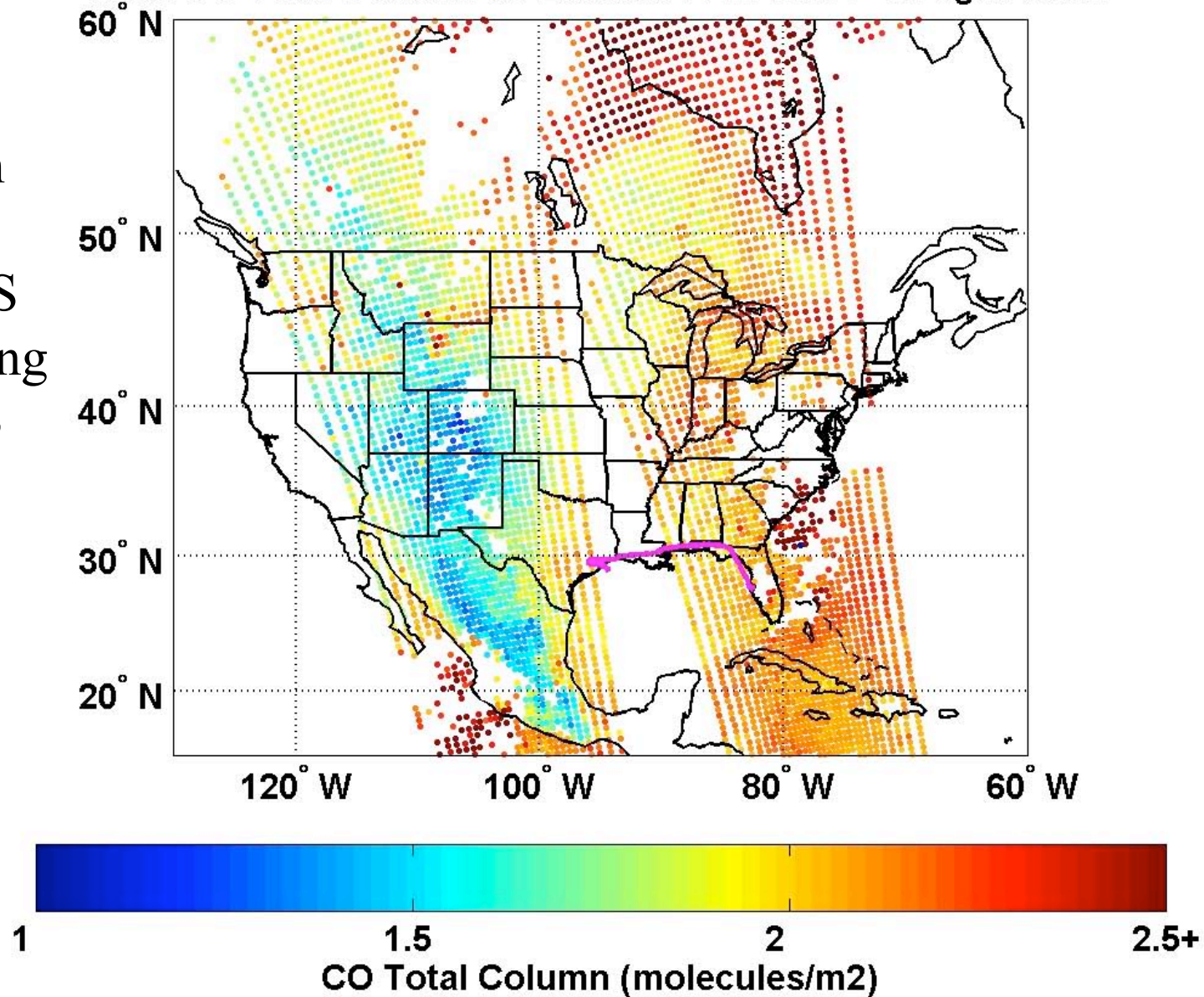
RAQMS_{retrieved} CO column
is highly correlated ($r=0.78$)
with AIRS CO column over
CONUS but has a slight
($0.08 \times 10^{18} \text{ mol/cm}^2$) high bias,
particularly south of 35°N

Courtesy of Brad Pierce, TEXAQS RSS Presentation 9/15/06

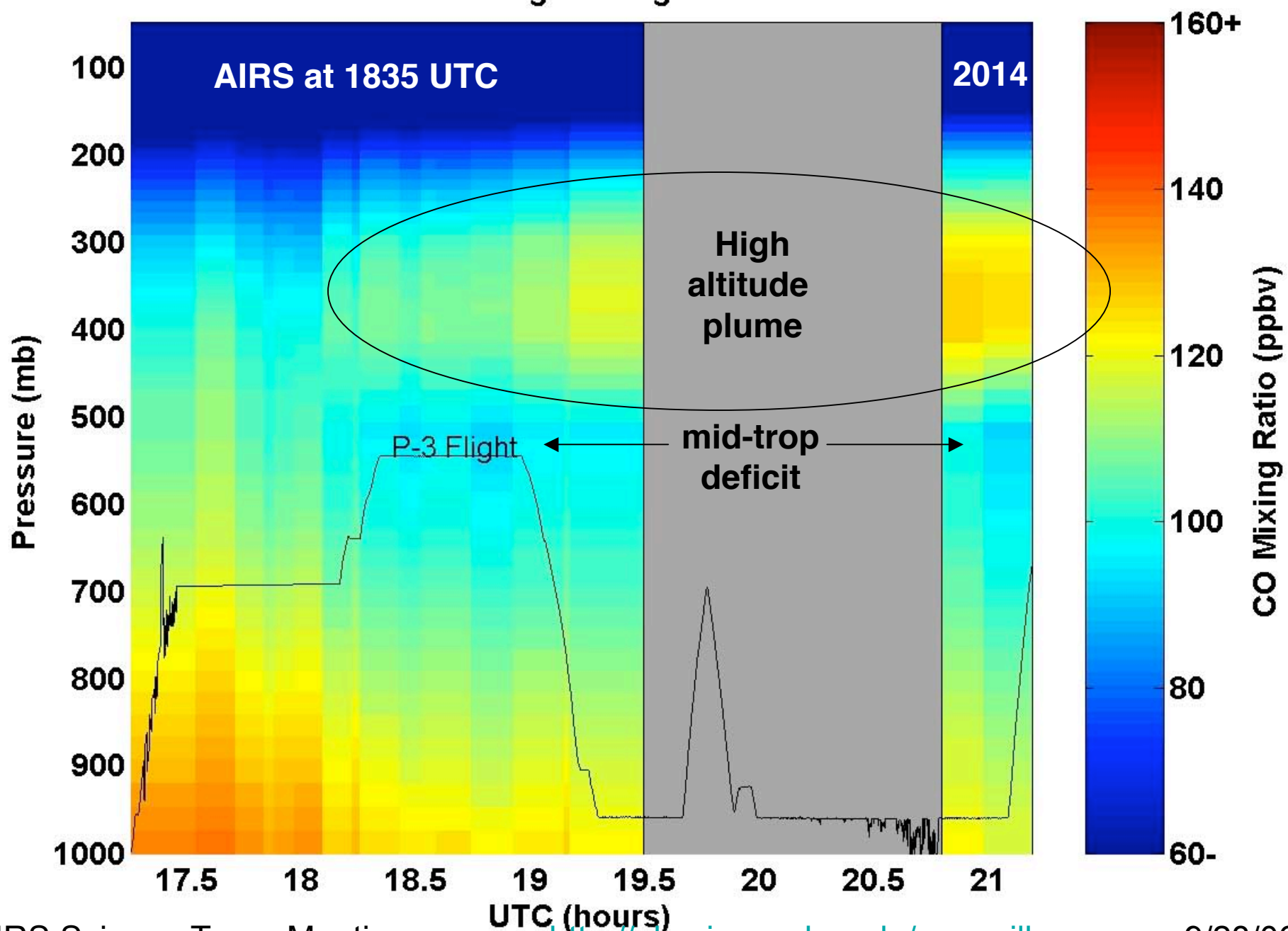
v4.2 Research

AIRS CONUS
coverage during
the NOAA P3
flight

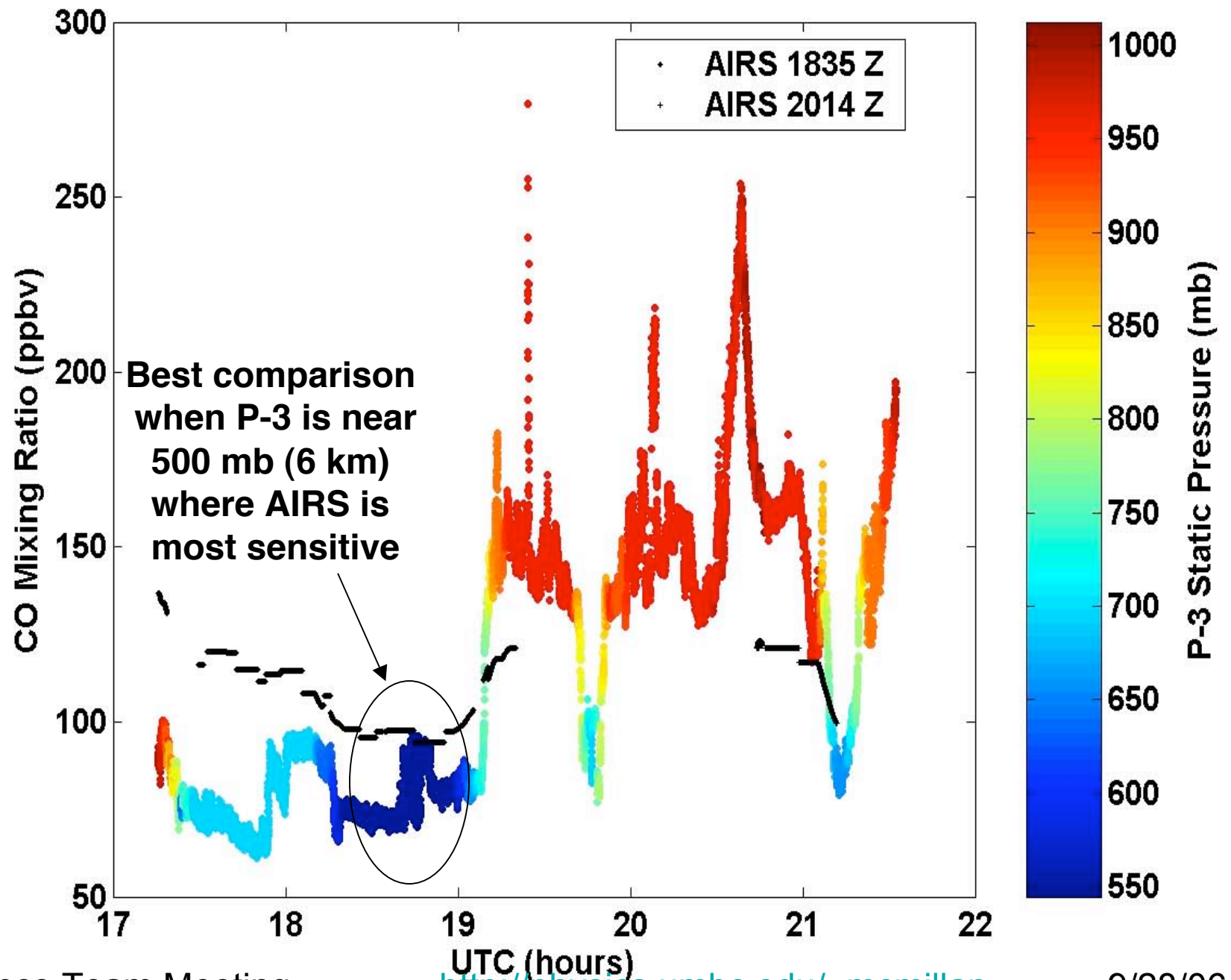
AIRS CO Total Column on 20060831 PM with P-3 Flight-track



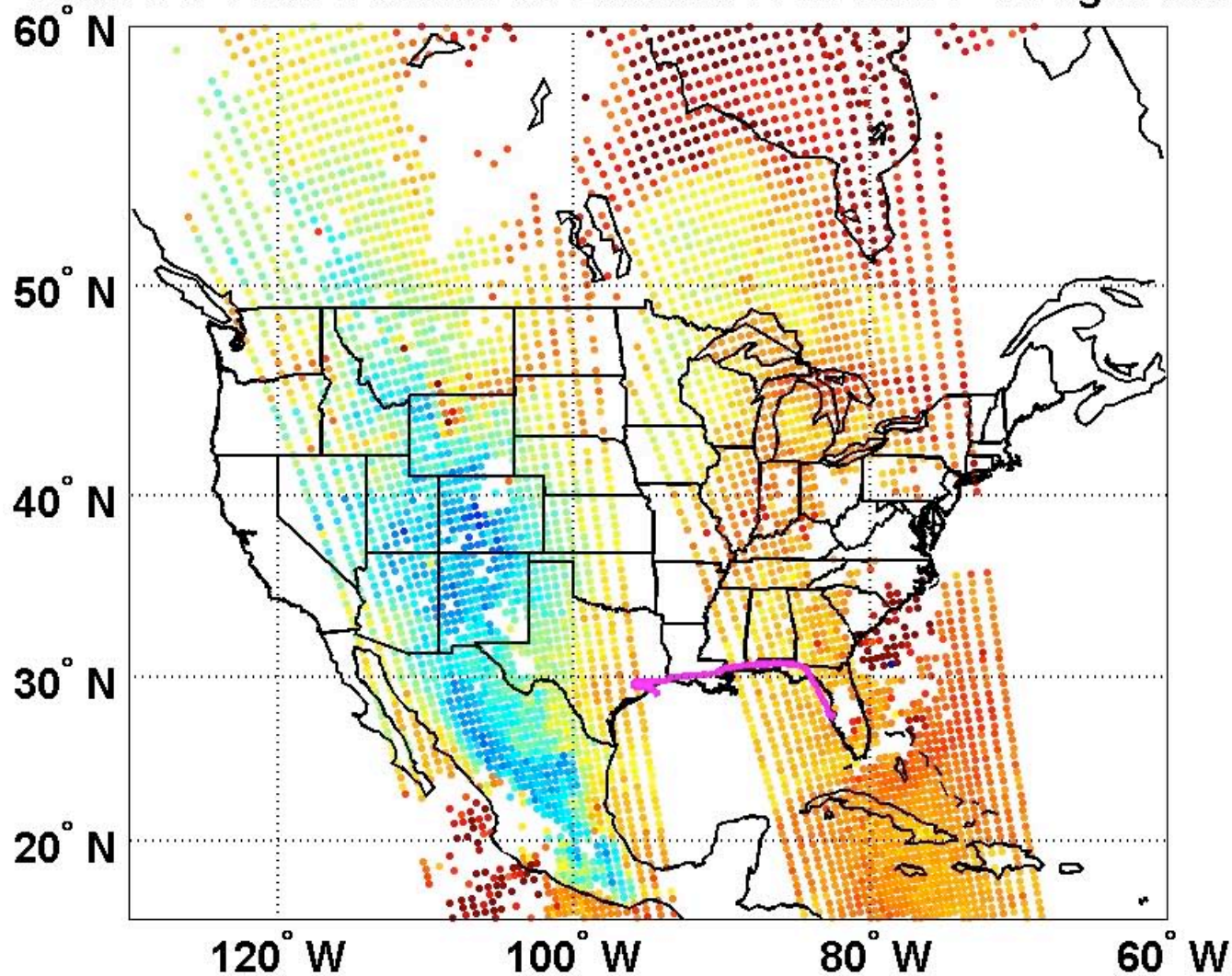
AIRS CO Curtain along P-3 Flight-track: 20060831



P-3 In Situ CO vs. AIRS Retrieved CO at P-3 Pressure: 20060831



AIRS CO Total Column on 20060831 PM with P-3 Flight-track



1

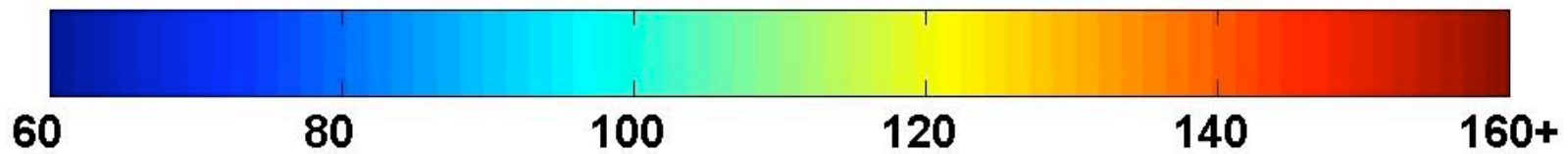
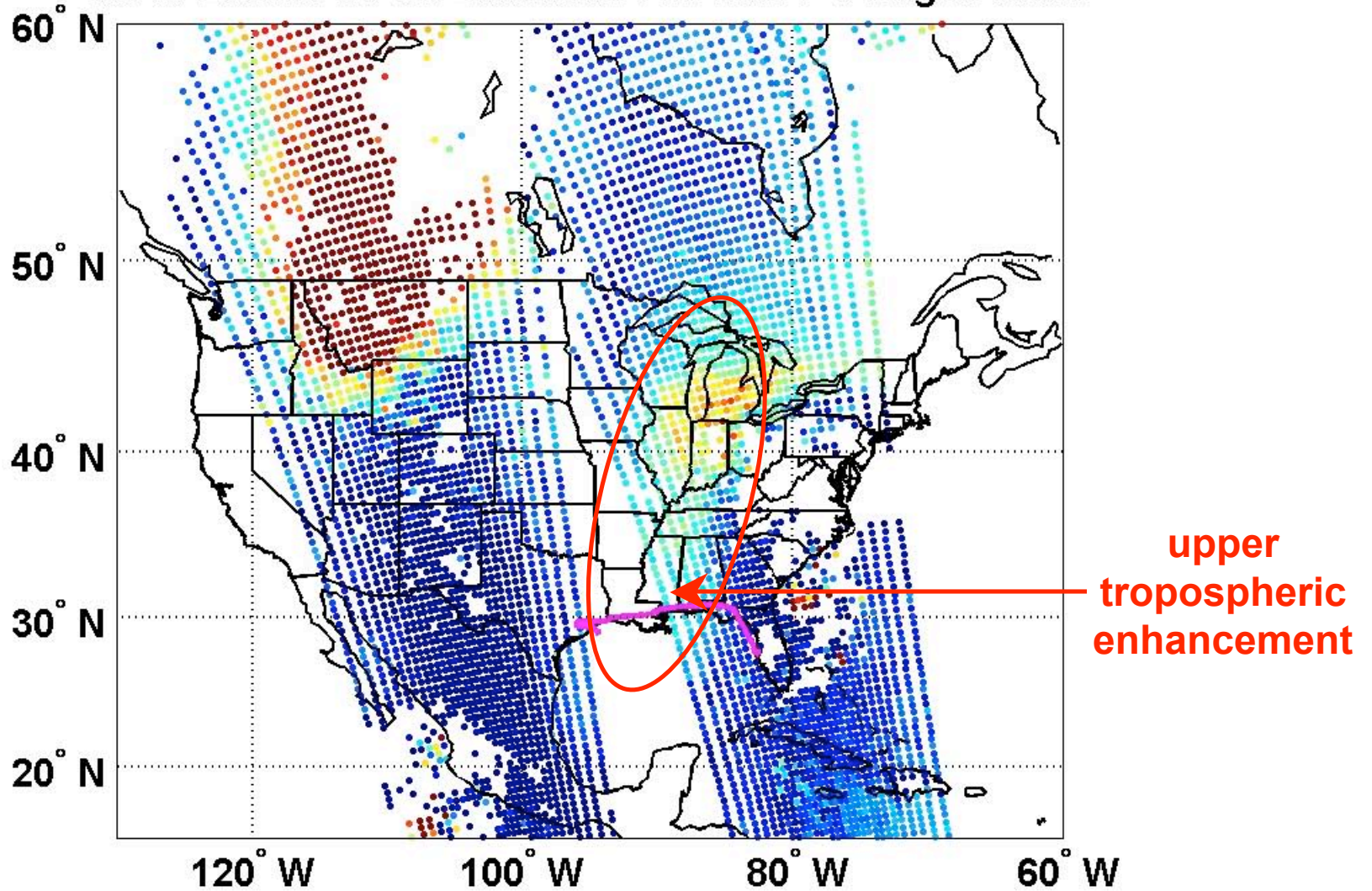
1.5

2

2.5+

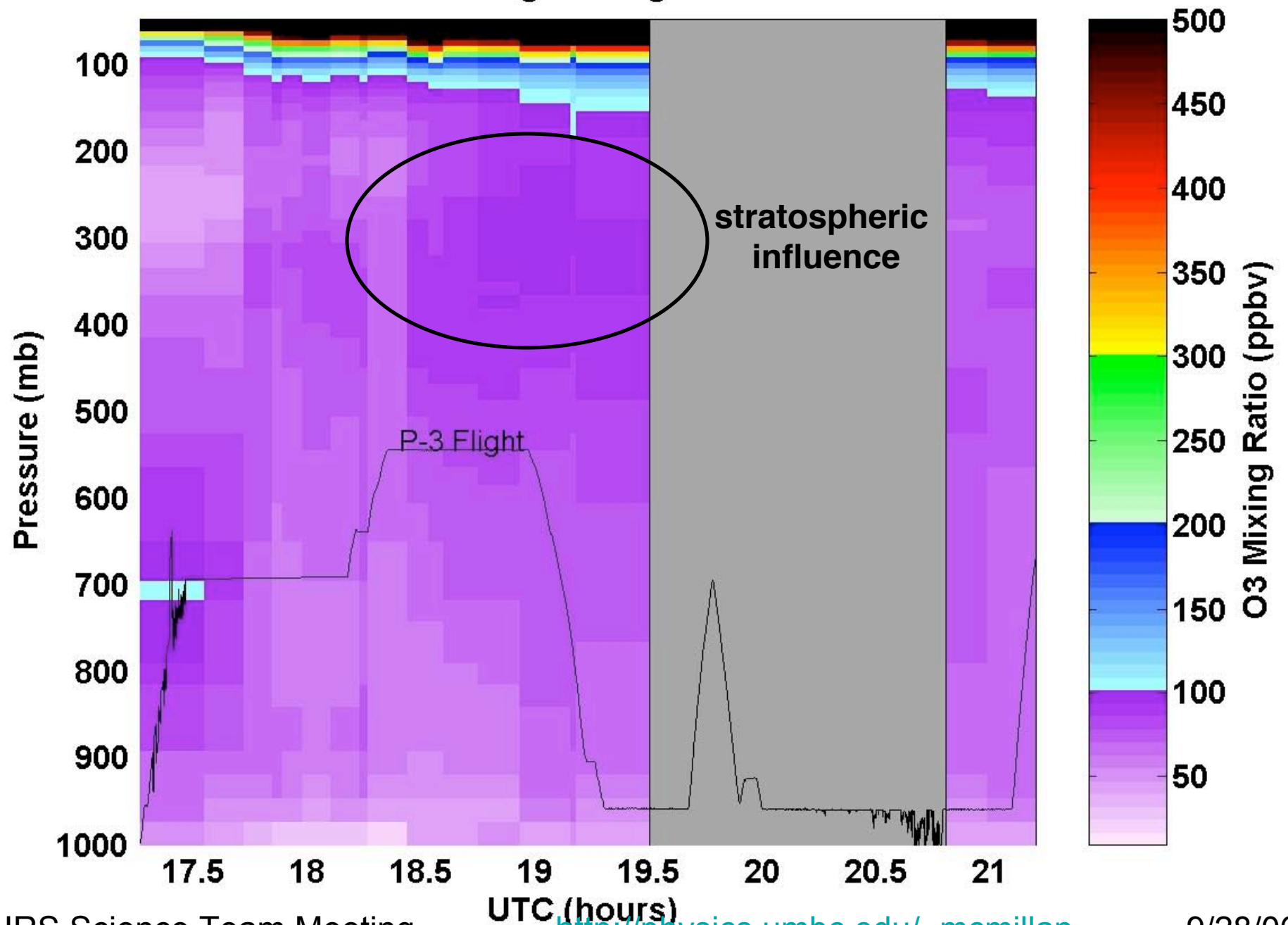
CO Total Column (molecules/m²)

AIRS 266mb O3 on 20060831 PM with P-3 Flight-track

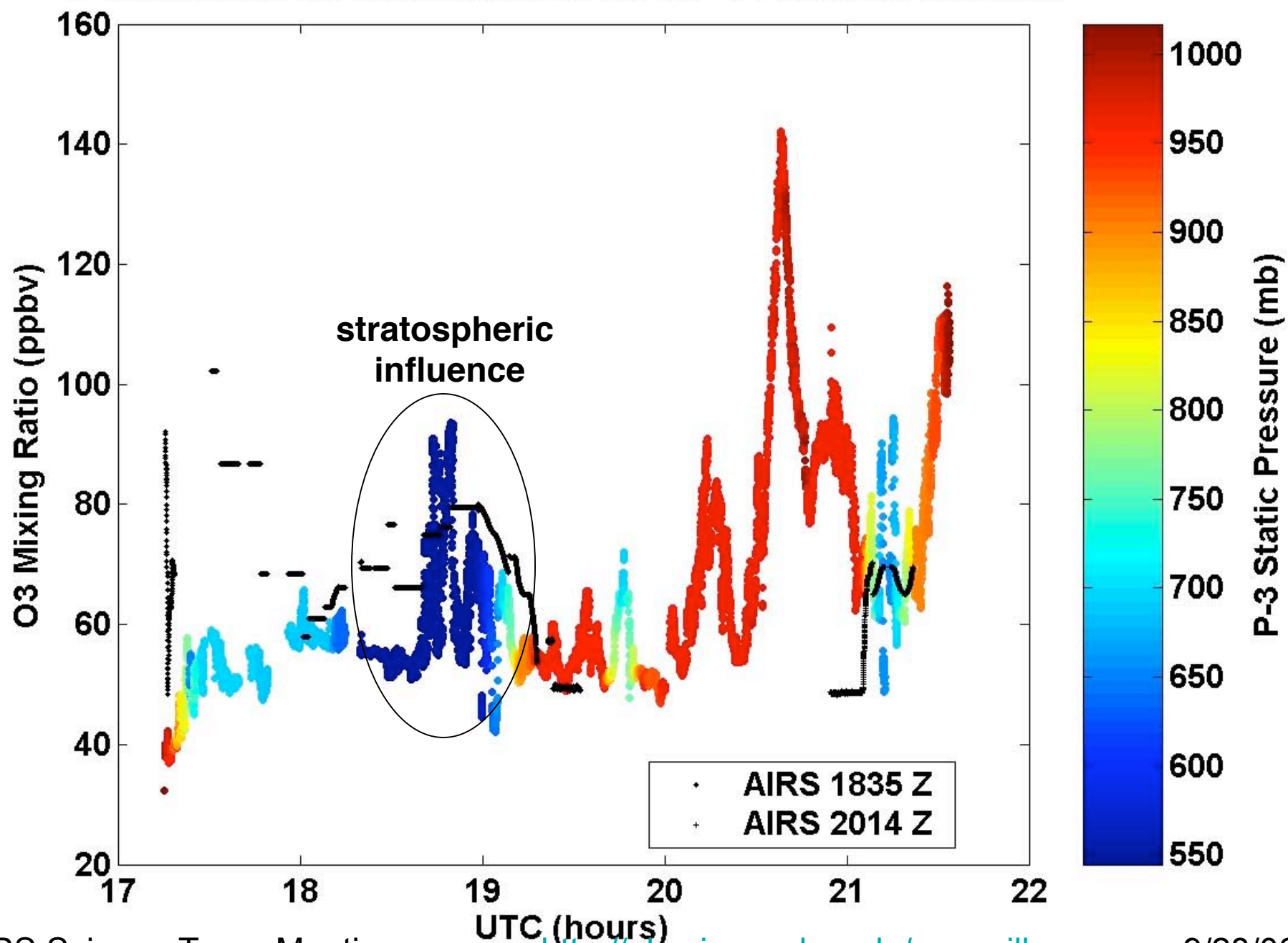


O3 Mixing Ratio (ppbv) at 266 mb

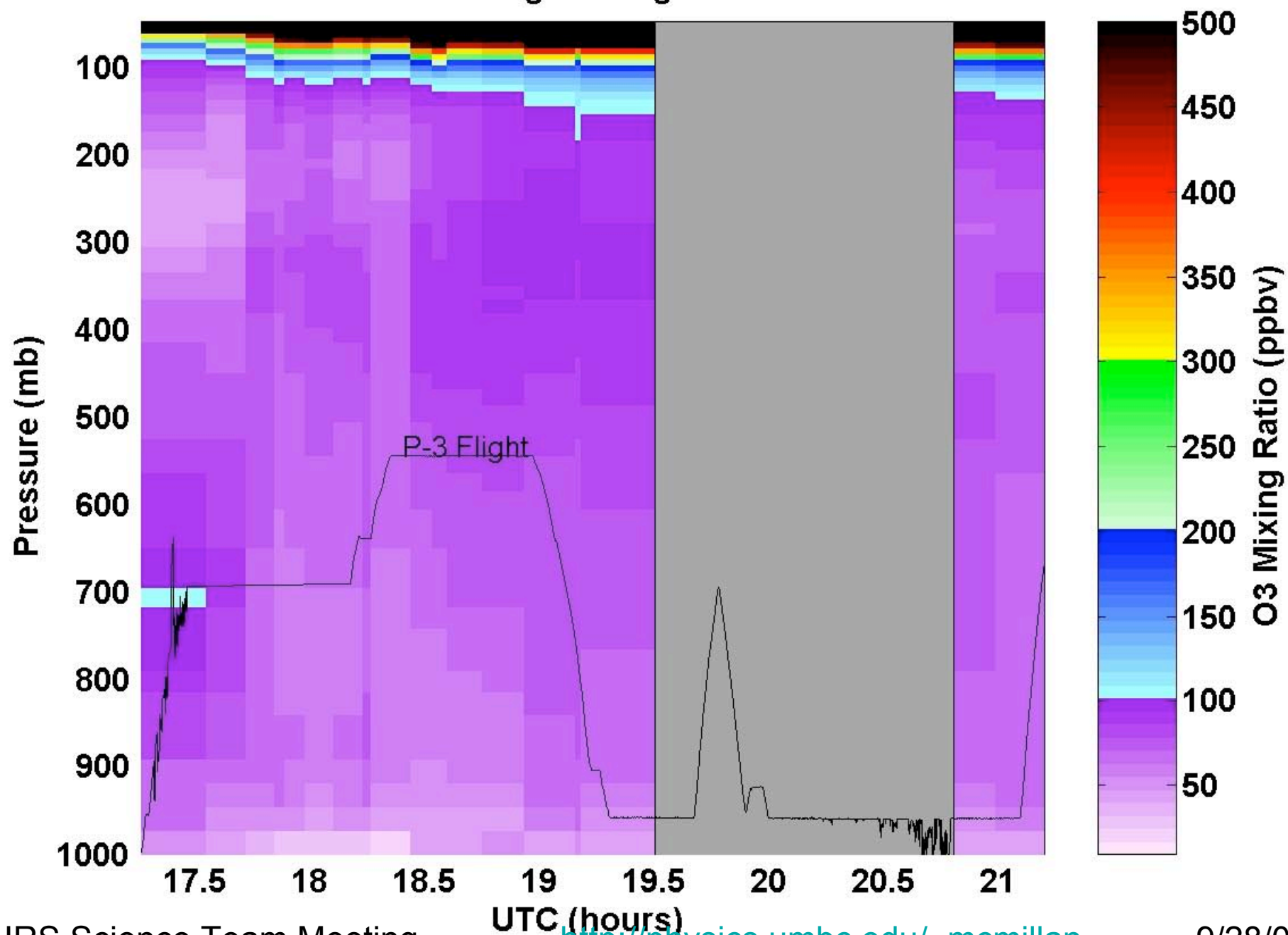
AIRS O3 Curtain along P-3 Flight-track: 20060831



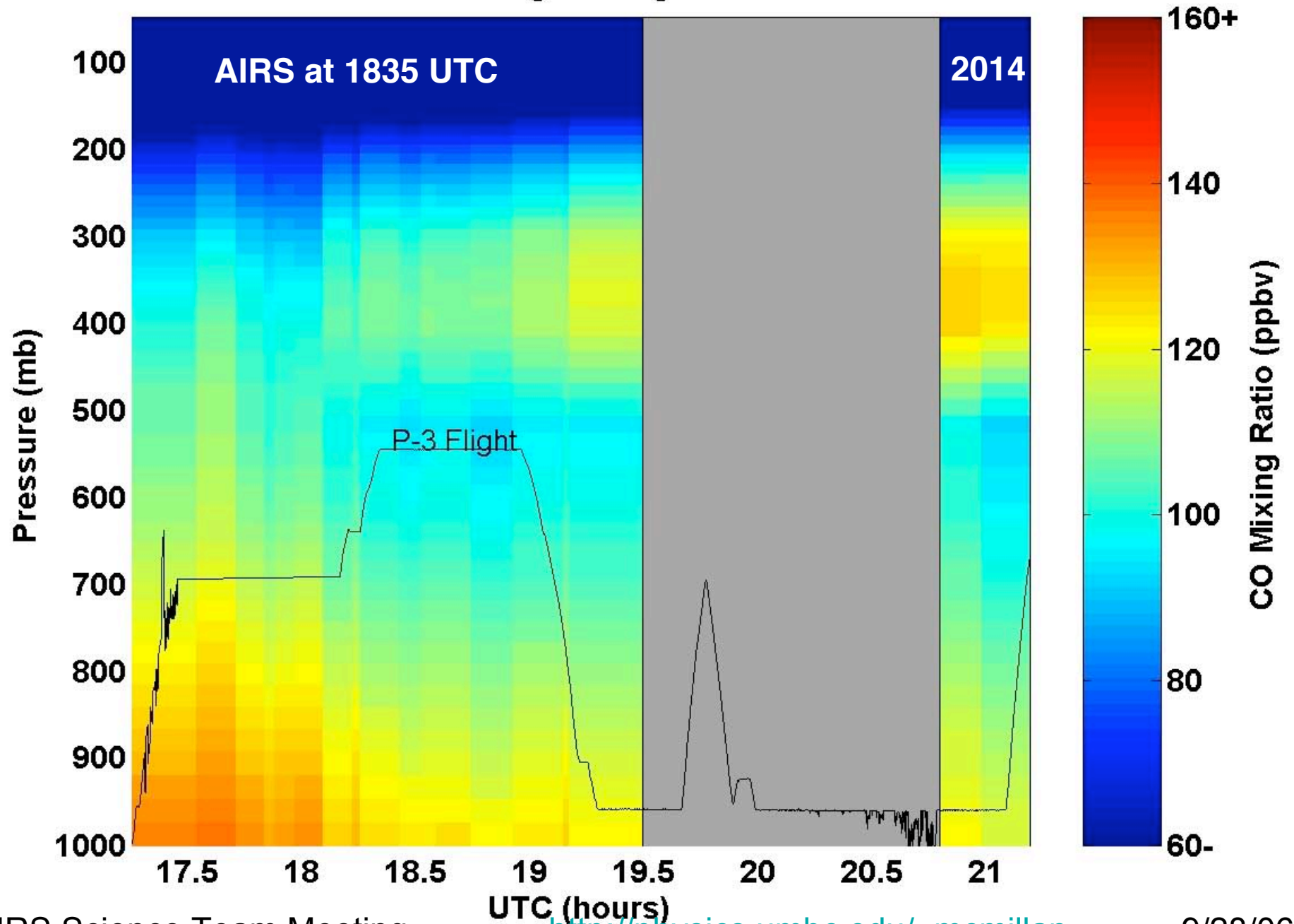
P-3 In Situ O3 vs. AIRS Retrieved O3 at P-3 Pressure: 20060831



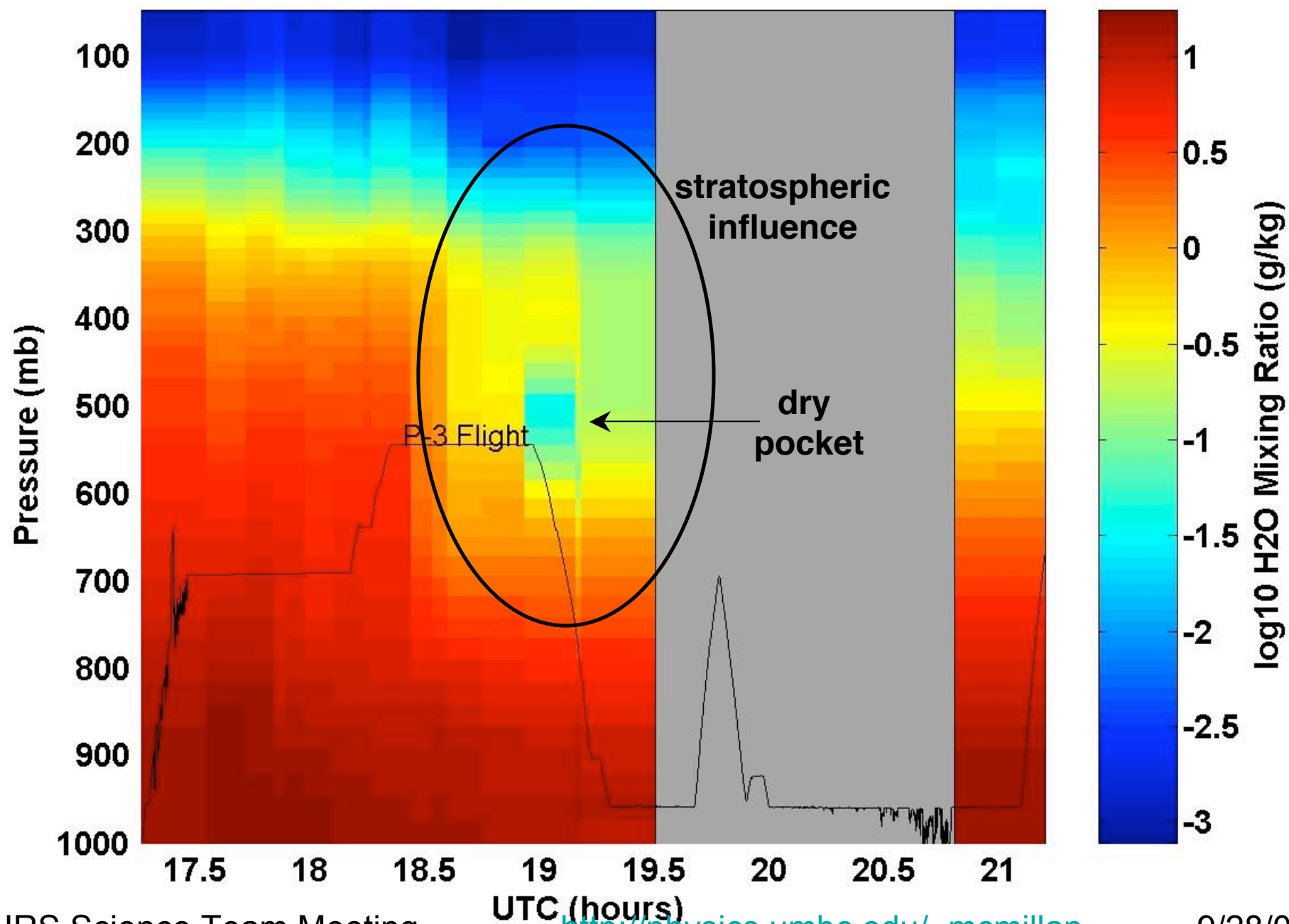
AIRS O3 Curtain along P-3 Flight-track: 20060831



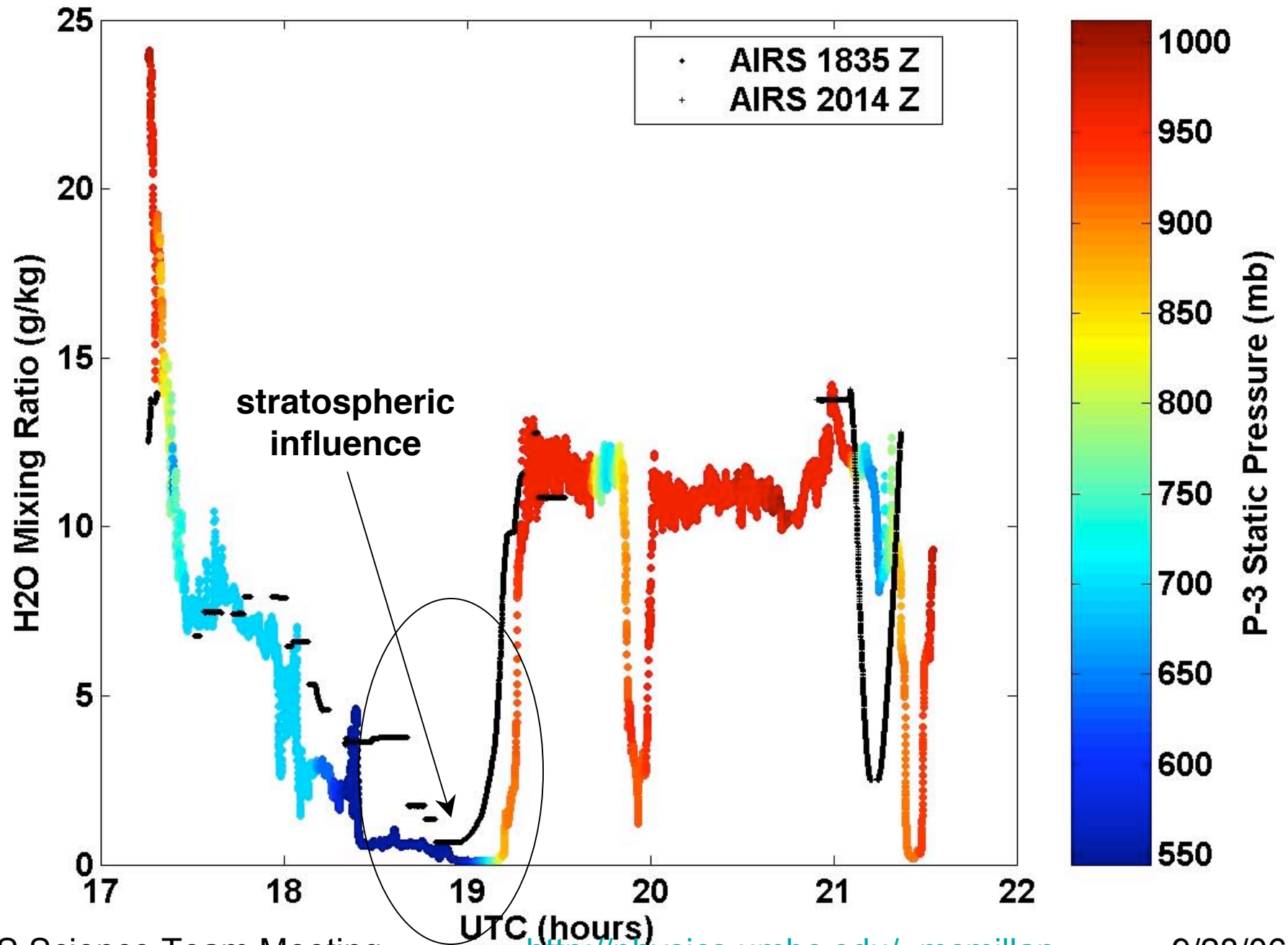
AIRS CO Curtain along P-3 Flight-track: 20060831



AIRS H₂O Curtain along P-3 Flight-track: 20060831



P-3 In Situ H2O vs. AIRS Retrieved H2O at P-3 Pressure: 20060831



Summary

- Synthesis of Houston AIRNOW, NOAA P3, NASA AIRS measurements, and RAQMS predictions:
 - Demonstrates impact of distant sources to Houston air quality.
 - AIRS provides regional context for interpretation of ground and airborne measurements.
 - Model and trajectory analysis provides link between local air quality and regional observations.
 - Comparisons to P3 guide interpretation of model predictions and AIRS observations.
- Integration of AIRS multiple specie retrievals is critical to geophysical interpretation
 - Models and in situ guide our understanding